

Announcement of Opportunity

NASA's

Second Stand Alone Missions of Opportunity Notice (SALMON-2)

**Notice of Intent to Propose Due Dates:
Proposal Due Dates:**

**See program appendices
Through February 6, 2017;
See program appendices**

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ANNOUNCEMENT OF OPPORTUNITY
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)
NNH12ZDA006O

FOREWORD

This National Aeronautics and Space Administration (NASA) Announcement of Opportunity (AO), entitled *Second Stand Alone Missions of Opportunity Notice (SALMON-2)*, provides a solicitation and procurement base for opportunities for modest investigations requiring space flight that advance the high priority science, exploration, and technology objectives of NASA's Science Mission Directorate, Human Exploration and Operations Mission Directorate, and the Office of the Chief Technologist.

Traditionally, Mission of Opportunity (MO) investigations have been solicited in conjunction with NASA's Science Mission Directorate's (SMD's) Announcements of Opportunity (AO) for Principal Investigator (PI)-led missions (*e.g.*, Discovery, Earth Venture, Explorer, and New Frontiers). In 2008, NASA released the omnibus SALMON AO, which incorporates regular Program Element Appendices (PEAs) for general MO proposal opportunities, as well as focused proposal opportunities for specific flight opportunities. The SALMON AO may include U.S. and non-U.S.-led mission opportunities.

This SALMON-2 accomplishes the same purpose but has been rewritten to: clearly and unambiguously state the policies that govern the solicitation, evaluation, selection, and implementation of modest space investigations; standardize the language and policies, to the maximum extent possible, that all mission directorates use in soliciting modest space investigations; simplify the nature of the response necessary by clearly and unambiguously stating and numbering the requirements that all proposals shall meet in order to represent a compliant response to this AO; and separate requirements that apply to proposals from the program policies and requirements that apply to investigations that have been selected to proceed into formulation.

This SALMON-2 AO does not, in and of itself, solicit proposals. The actual solicitation is enabled by a PEA that is appended to the SALMON-2 AO. The AO provides the standard requirements for all SALMON-2 solicitations with program specific requirements called out in a PEA for a specific solicitation and proposal opportunity. Program specific requirements spelled out in the PEA include the scope of the solicitation, the available funding, the proposal due date, and other program specific requirements as well as deviations from SALMON-2 standard requirements.

Requirements governing proposal content will be found, for the most part, in Section 5 and Appendix B of this AO. The rest of the AO contains NASA policies and practices for implementing space flight projects that may aid the proposer in developing a response to this AO. These policies and practices include requirements that will apply to any proposed investigation that is selected by NASA for further definition and implementation.

PEAs will solicit proposals addressing specific topics of interest from one or more of the NASA Mission Directorates. PEAs are added to this AO throughout the five years by amending the AO. Proposals will typically be solicited in one or more of four MO categories: Partner Missions of Opportunity, New Missions using Existing Spacecraft, Small Complete Missions, and Focused Opportunities.

Selection announcements are anticipated to occur within nine months of the release of the applicable PEA. This approach will enable NASA and the space community to maximize their participation in U.S. and non-U.S. space flight missions of opportunity.

Proposers should be aware of the following major changes in this SALMON-2 AO from the Draft SALMON-2 AO (NNH11ZDA017J) that was released on August 24, 2011.

- The governing revision of NPR 7120.5 has been changed to reference the second NASA interim directive for NPR 7120.5D, document NM 7120-97 (Section 4.1.1, NASA Space Flight Project Management).
- There are no limitations on the participation of Aerospace in proposals unless a specific PEA states that Aerospace is under a partial limitation for that PEA (Section 4.2.1, Eligibility to Participate in this AO).
- Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement (Section 4.2.2, Restrictions Involving China).
- Alternative access to space may include a hosted payload on a foreign-manufactured launch vehicle subject to the exemption requirement and other prescriptions in the U.S. Space Transportation Policy (Section 4.6, Launch Services Policies).
- Requirements for proposing non-NASA launch services have been added (Section 5.3.5, Launch Services).
- The adequacy of the proposed cost reserves must be demonstrated in the proposal, even if the cost reserves are set to the minimum requirement for cost reserves (Section 5.5.2, Cost Estimating Methodologies and Cost Reserve Management).

In addition to the listed changes, this AO incorporates additional clarifications, corrections, and other changes relative to the Draft SALMON-2 AO. All proposers must read this AO carefully, and all proposals must comply with the requirements, constraints, and guidelines contained within this AO.

This SALMON-2 AO replaces the 2008 release of SALMON (NNH08ZDA0090). As of the release of this SALMON-2 AO, the SALMON 2008 AO is closed and no further amendments or Program Element Appendices (PEAs) will be released for the SALMON 2008 AO.

Questions or requests for further information about specific proposal opportunities may be addressed to the Point-of-Contact identified in the applicable PEA. General questions regarding this SALMON-2 AO may be addressed to **Dr. Jeffrey Newmark, Deputy AA for Research Science Mission Directorate, NASA, Washington, DC 20546; Telephone: 202-358-0684; Email: jeffrey.newmark@nasa.gov. [Point of Contact updated August 15, 2016]**

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1. Description of Opportunity

1.1 Introduction

The National Aeronautics and Space Administration (NASA) announces the opportunity to conduct space flight investigations in science, exploration, and technology of modest cost and scope as Missions of Opportunity (MO). Proposed investigations must address one or more of the goals established in the *2011 NASA Strategic Plan* to achieve the national vision to drive advances in science, exploration, and technology to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth. The *2011 NASA Strategic Plan* may be found as NASA Policy Directive (NPD) 1001.0A in the NASA Online Directives Information Service (NODIS) at <http://nodis.gsfc.nasa.gov/>.

Working to meet these strategic goals are NASA's Mission Directorates and the Office of the Chief Technologist¹:

- The Science Mission Directorate (SMD) engages the Nation's science community, sponsors scientific research, and develops and deploys satellites and probes in collaboration with NASA's partners around the world to answer fundamental questions requiring the view from and into space. SMD carries out the scientific exploration of Earth and space to expand the frontiers of Earth science, heliophysics, planetary science, and astrophysics. See <http://science.nasa.gov/> for additional information.
- The Human Exploration and Operations (HEO) Mission Directorate (HEOMD) is responsible for NASA space operations in and beyond low-Earth orbit, developing new transportation systems, developing critical supporting capabilities, and performing scientific research to expand scientific knowledge and human capabilities in space and enable sustained and affordable human exploration. HEO also manages crosscutting activities related to Launch Services, Space Communications and Navigation, and Rocket Propulsion Test in support of human and robotic exploration requirements. See <http://www.nasa.gov/directorates/heo/> for additional information.
- The Office of the Chief Technologist (OCT) is responsible for NASA's Space Technology initiative which will develop and demonstrate advanced space systems concepts and technologies enabling new approaches to achieving NASA's current mission set and future missions not feasible today. OCT will focus its investments on technologies that are either crosscutting, which serve multiple NASA Mission Directorates, industry, and other

¹ Throughout this AO, the term "NASA Mission Directorate" is intended to include the Office of the Chief Technologist as well as the Human Exploration and Operations Mission Directorate and the Science Mission Directorate. Likewise the title "Mission Directorate Associate Administrator" is intended to include the NASA Chief Technologist as well as the AAs of the mission directorates.

government agencies, and/or game-changing which enable currently unrealizable approaches to space systems and missions. OCT will complement the technology development activities within NASA's Mission Directorates, leveraging synergies between them, and delivering forward-reaching technology solutions for future NASA science and exploration missions, and significant National needs. See <http://www.nasa.gov/offices/oct/> for additional information.

NASA requires the flexibility to respond to and participate in space flight missions of opportunity that advance high priority science, exploration, and technology objectives. The dynamic nature in which most national and international flight missions evolve from design concepts into funded missions requires solicitations for collaborative investigations to be reviewed and awarded in a standard and expedient manner. The entire process – from the release of a Program Element Appendix (PEA) as an amendment to this standing Announcement of Opportunity (AO) to announcement of selections – is anticipated to take no more than nine months. This short duration solicitation process allows NASA to tailor program requirements to meet national priorities for science, exploration, and technology, and it provides a standard mechanism for rapidly responding to space flight opportunities on non-U.S. as well as U.S. Government and non-government spacecraft.

1.2 NASA Safety Priorities

Safety is the freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. NASA's safety priority is to protect: (1) the public, (2) astronauts and pilots, (3) the NASA workforce (including NASA employees working under NASA instruments), and (4) high-value equipment and property.

1.3 Online References

All NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents referenced in this AO may be found in the NASA Online Directives Information Service (NODIS) at <http://nodis.gsfc.nasa.gov/>.

NASA technical standards documents may be found in the public access portion of the NASA Standards and Technical Assistance Resource Tool (START) at <http://standards.nasa.gov/>. NASA technical reports may be found on the NASA Technical Reports Server (NTRS) at <http://ntrs.nasa.gov/search.jsp>.

The Federal Acquisition Regulations (FAR) are available at <http://www.acquisition.gov/far/> [updated December 12, 2014]. The Code of Federal Regulations (CFR) and the United States Code (USC) are available at <http://www.gpo.gov/fdsys/>. Executive Orders may be accessed at <http://www.archives.gov/federal-register/executive-orders/>.

The NASA FAR Supplement (NFS) may be accessed at <http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm>. NASA Procurement Information Circulars (PIC) may be accessed at <http://www.hq.nasa.gov/office/procurement/regs/pic.html>.

2. AO Objectives

2.1 NASA's Strategic Goals

The NASA Vision is “To reach for new heights and reveal the unknown, so what we do and learn will benefit all humankind.”

The NASA Mission is to “Drive advances in science, technology, and exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth.”

To advance the Vision and Mission, the *2011 NASA Strategic Plan* lays out strategic goals. This AO solicits investigations that advance NASA's strategic goals in science, exploration, and technology.

- Science: Expand scientific understanding of the Earth and the universe in which we live (Strategic Goal 2).
- Exploration: Extend and sustain human activities across the solar system (Strategic Goal 1).
- Technology: Create the innovative new space technologies for our exploration, science, and economic future (Strategic Goal 3).

2.2 Objectives in Science, Exploration, and Technology

NASA pursues its strategic goals using a wide variety of space flight programs that enable remote sensing, *in situ* investigations, exploration, and technology demonstrations. These investigations are carried out through flight of space missions in Earth orbit, to the Moon, and to or beyond objects in the Solar System, as well as through suborbital flights and ground-based research activities that directly support these space missions.

This AO solicits investigations in science, exploration, and technology.

Science investigations are directed at expanding scientific understanding through basic and applied research in those areas of science that study the space environment, that benefit from performing the research in the space environment, and that take advantage of the view from space. Although a specific PEA might solicit science investigations in any science discipline that contributes to NASA's goals and objectives, most NASA-sponsored science is in the disciplines of astrobiology, astrophysics, Earth science, heliophysics, microgravity science, planetary science and space biology.

Exploration investigations are directed at developing the knowledge and capabilities required to extend and sustain human activities across the solar system. Although a specific PEA might solicit exploration investigations in any area that contributes to NASA's goals and objectives, exploration investigations are often directed at lowering the risk for future extended-duration human space missions through research in radiation exposure, behavioral health, and fitness in space and at acquiring strategic knowledge necessary to enable future human space activities

through the conduct of critical observations and measurements, the test of operations concepts, the demonstration of technologies, and the identification of specific target destinations.

Technology investigations are directed at developing and demonstrating the innovative new technologies required for our exploration, science, and economic future. Although a specific PEA might solicit technology investigations in any area that contributes to NASA's goals and objectives, technology investigations are often directed at identifying advanced concepts and emerging technologies, at maturing advanced space technologies that may lead to new approaches for the Agency's future space missions and solutions to significant national needs, and at maturing space technology to the point of infusion into the critical path for future missions through relevant environment testing and technology demonstration space flights when necessary.

This solicitation invites the NASA community to participate in conducting science, exploration, and technology investigations with NASA. The NASA community includes the science, exploration, engineering, technology, and other communities within educational, industrial, and not-for-profit organizations, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), NASA Centers, the Jet Propulsion Laboratory (JPL), and other Government agencies, as well as non-U.S. partner organizations.

2.3 Categories of Missions of Opportunity

This Second Stand Alone Mission of Opportunity Notice (SALMON-2) AO invites proposals for Missions of Opportunity. A Mission of Opportunity (MO) is a focused space flight investigation that offers high scientific, exploration, or technical value for a modest cost to NASA.

SALMON-2 MO investigations fall into four categories – Partner Missions of Opportunity (PMOs) (Section 5.1.1), New Missions using Existing Spacecraft (NMESs) (Section 5.1.2), Small Complete Missions (SCMs) (Section 5.1.3), and Focused Missions of Opportunity (FMOs) (Section 5.1.4)².

- PMOs are investigations that provide a critical component of a non-NASA or non-U.S. mission. By supporting U.S. participation in PMO investigations, NASA seeks to allow the NASA community the opportunity to conduct an investigation of interest to NASA by providing a critical part of a non-NASA or non-U.S. space mission – such as a complete instrument, or hardware or software components.
- NMESs are investigations that propose a new use of existing NASA spacecraft. The NMES opportunity solicits proposals making use of a NASA spacecraft or other working space asset to conduct an investigation that is not a continuation of the spacecraft's original mission.

² Opportunities for U.S. Participating Investigators (USPI), which were included in the SALMON 2008 AO, will be solicited in the future through the Research Opportunities in Space and Earth Sciences (ROSES) NASA Research Announcement (NRA) (for the Science Mission Directorate) and through other NASA Broad Agency Announcements (BAAs).

- SCMs are scientifically valuable investigations that can be realized within the specified cost cap, including the cost of their access to space if not provided by NASA. The SCM opportunity permits targeted, compelling investigations to be proposed at a much lower cost than Small Explorer (SMEX) or Earth Venture (EV) missions.
- FMOs are investigations that address a specific, NASA-identified flight opportunity.

2.4 Objectives of Specific Program Elements

MO investigations may be proposed in response to specific Program Elements. A Program Element may provide a general proposal opportunity within a specific division of a NASA Mission Directorate for conducting investigations in space. A Program Element may also provide a focused solicitation directed at a specific opportunity identified by NASA for conducting investigations in space. An example of a focused opportunity would be NASA-provided instruments, hardware components, or microgravity experiments for a mission sponsored by another space agency with which NASA has established a strategic partnership.

As needed, Program Elements will be added by amending the SALMON-2 AO in the form of “Program Element Appendices” (PEAs). These will be released to meet general or specific mission opportunities. PEAs will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. PEAs may include exceptions to requirements defined in the SALMON-2 AO; any such exceptions will take precedence over their corresponding requirements in the main SALMON-2 AO. Each PEA will specify the funding available for selected proposals.

2.5 Single Step Selections

Unless stated otherwise in the applicable PEA, proposed investigations will be evaluated and selected through a single step competitive process. This single step is the solicitation, submission, evaluation, and selection of proposals prepared in response to this AO and the applicable PEA.

3. Proposal Opportunity Period

Each PEA is a separate and independent solicitation; each PEA will have its own solicitation identifier in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) and its own funding for selected investigations. Each PEA will specify a due date for proposals, as well as requirement and constraints for that specific solicitation, including the sponsoring NASA Headquarters (HQ) mission directorate and division, the type of MO, the cost cap, and any launch-by or commitment-by dates. Specific schedules and due dates will be included in each PEA. NASA anticipates that selections will be announced within nine months of the release of a PEA.

Requirement 1. Proposals submitted in response to a PEA shall be delivered no later than the proposal submittal deadline stated in the applicable PEA.

Requirement 2. Proposals shall be delivered electronically through NSPIRES at the URL provided in Section 6.2.3 of this AO.

4. Policies Applicable to this AO

4.1 NASA Management Policies

The following policies do not levy requirements on proposals *per se*. They impose requirements only on those investigations that are selected through the evaluation process described in Section 7 of this AO, for which planning may need to be considered and described as part of the proposal process.

4.1.1 NASA Space Flight Project Management

Proposals selected in response to this AO will be implemented in accordance with NASA space flight project management processes. NASA space flight project management processes, as defined by NPR 7120.5D NID³, *NASA Space Flight Program and Project Management Requirements*, are Formulation, Approval, Implementation, and Evaluation. The NASA space flight project management processes are subdivided as follows:

Formulation is divided into:

- Phase A – Concept and Technology Development; and
- Phase B – Preliminary Design and Technology Completion.

Approval is the process for transitioning into Implementation, which for Missions of Opportunity is the step leading to a Confirmation Review with the appropriate Mission Directorate Associate Administrator.

Implementation is divided into:

- Phase C – Final Design and Fabrication;
- Phase D – System Assembly, Integration and Test, and Launch (extending through in-orbit checkout);
- Phase E – Operations and Sustainment; and
- Phase F – Closeout.

Phase E includes analysis and publication of data in the peer reviewed scientific and/or technical literature and delivery of the data to an appropriate NASA data archive (see Section 4.4.3).

Evaluation is the ongoing independent review and assessment of the project's status during both Formulation and Implementation.

A Key Decision Point (KDP) occurs before the project is approved to begin the next phase of development; KDPs are defined in NPR 7120.5D NID. For missions selected as a result of this AO, KDP-A is the selection of a proposal for a concept study, KDP-B is the entry to Phase B following the System Requirements Review, KDP-C is the culmination of the Confirmation process, KDP-D is a transition that occurs after the Systems Integration Review, KDP-E is the handoff from development to operations, and KDP-F is the decision to terminate operations after

³ NPR 7120.5D NID is the second NASA Interim Directive (NID) for NPR 7120.5D. Effective October 3, 2011, NPR 7120.5D NID (document number NM 7120-97) is the governing NPR until NPR 7120.5D is formally revised.

completion of the mission. Scientific and other analyses, including data analysis and preliminary analysis of returned samples, may continue under project funding in Phase F.

4.1.2 NASA Program Management

Owing to the significant expenditure of government funds on these spaceflight investigations, as well as to their expected complexity, NASA intends to maintain an essential degree of insight into the project. NASA will exercise essential oversight to ensure that the implementation is responsive to NASA requirements and constraints. NASA requirements and constraints are defined in NPR 7120.5D NID and other NASA requirements documents that are available in NODIS.

Each PEA will designate a Program Office and associated NASA Center (including JPL) that has been assigned management responsibility for that Program Element of the SALMON-2 AO. In this role, which is separate from the Center's role as a potential partner in the investigation, the designated Program Office is responsible for NASA's fiduciary responsibility to ensure that selected SALMON-2 investigations are achieved in compliance with the cost, schedule, performance, reliability, and safety requirements to which the Principal Investigator (PI) has committed.

The designated Program Office will be responsible for monitoring the project's progress, and will maintain sufficient insight into the development activities to ensure that cost, schedule, and technical performance of the investigation remain within established boundaries. The level of each Program Office's involvement in this role may vary, depending on the implementing organization and other programmatic considerations. NASA HQ will designate specific NASA Center teams that will work with the selected PIs and implementing organizations to define roles and responsibilities to fulfill this responsibility in the most effective manner.

NPR 7120.5D NID defines project management responsibilities, and it presumes that project management is assigned to a NASA Center or JPL. If an organization other than a NASA Center or JPL is proposed and selected to provide project management for an investigation, the NASA Center's project management responsibilities under NPR 7120.5D NID will be assigned to the implementing project management organization. That organization must be prepared to carry out these responsibilities. In such cases, the Program Office at the designated Center or JPL will retain the Technical Authority (TA) described in NPR 7120.5D NID, which would otherwise be invested in the designated Center or JPL.

NPD 8700.3B, *Safety and Mission Assurance Policy for NASA Spacecraft, Instruments, and Launch Services*, and any program-specific *Safety, Reliability, and Quality Assurance Requirements* document identified in the applicable PEA, will apply to investigations that are selected. Selected investigations that reside at institutions that have NASA-approved safety and mission assurance (SMA) programs may utilize their own institutional practices in lieu of the guidelines and requirements in this document. Although these documents may impose requirements on selected investigations, they do not impose requirements, either implicitly or explicitly, on proposals developed in response to this AO.

In addition to its role as the site of the Program Office, the designated NASA Center is eligible to participate in proposals that are submitted in response to the applicable PEA. The Program Office will have access to the PEA before it is released; this is necessary so that the Program Office can review the PEA and ensure that it correctly describes the postselection project management processes. The Program Office contributes to defining the scientific, exploration, and technological scope of the PEA, writing the PEA, and evaluating proposals. The Mission Directorate at NASA Headquarters will manage the solicitation, evaluation, and selection process including sole responsibility for the selection process. In order to manage the designated NASA Center's two roles, the Mission Directorate has established functional and organizational firewalls between the Program Office and those parts of the Center that might participate in proposals. These firewalls ensure that personnel identified as supporting the Program Office and the AO process will protect all nonpublic information from all proposers, including those at the Center, and will be free of financial and other conflicts of interest with proposers.

4.1.3 NASA Center Role in Public Affairs and Outreach

Successful media relation activities require close cooperation between NASA and the selected investigations. NASA Centers and JPL have specific expertise in media relations and/or public affairs, especially as they pertain to NASA's science, exploration, and technology missions. All selected investigations will coordinate media relations and/or public affairs with a NASA Center or JPL. If a selected investigation does not include a NASA Center or JPL as part of their investigation team, the investigation will utilize the public affairs guidance and resources of the Program Office at the NASA Center designated in the applicable PEA.

NASA is to be informed in a timely manner of any newsworthy mission event or issue before public release of information. Strategies for using new and social media will also be developed collaboratively to ensure common and consistent messaging will occur in a timely manner. NASA and the selected investigation will establish and maintain a detailed coordination media relations plan and communications process.

Selected investigations must also work with NASA to ensure their mission website(s) adhere to NASA requirements for incorporating content for the agency's primary public website at <http://www.nasa.gov/>. NASA, and through NASA the selected investigation, is required under the Information Quality Act (44 USC 3504(d)(1) and 3516) and associated guidelines to maximize the quality, objectivity, utility, and integrity of information and services provided to the public.

4.1.4 Mission Category and Payload Risk Classification

NPR 7120.5D NID, *NASA Space Flight Program and Project Management Requirements*, establishes guidelines for categorizing NASA missions based on the estimated total mission cost and mission priority level. The mission categorization guidelines are given in Section 2.1.5 and Table 2-1 of NPR 7120.5D NID.

NPR 8705.4, *Risk Classification for NASA Payloads*, establishes baseline criteria that enable a definition of the risk classification level for NASA payloads. It defines four payload risk levels or classes, A thru D, and provides guidance for programmatic options during development based on this class. The requirements for each class are specified in Appendix B of NPR 8705.4.

As appropriate, the PEA will specify the mission category and the payload risk classification that will be applied to selected investigations.

4.1.5 Remediation, Termination, or Cancellation

Any alteration of an investigation that renders it unable to accomplish one or more of its baseline science, exploration, or technology objectives will be regarded as a descope of the investigation. NASA will review any such descoped set of achievable objectives to ensure that the investigation remains at or above the Threshold Investigation (see Section 5.2.4). A descope made necessary by the PI's inability to remain within budget or schedule, or failure at any time during formulation and implementation to maintain a level of science, exploration, or technology return at or above the Threshold Investigation, can result in investigation cancellation accompanied by appropriate contract action, which may involve termination.

Each investigation is based on the proposal submitted in response to this AO and the applicable PEA. The proposal must include a commitment by the PI for the PI-Managed Mission Cost, schedule, and scientific, exploration, or technology performance of the investigation. If, at any time, the cost, schedule, or performance commitments made in the proposal appear to be in peril, the investigation will be subject to termination or cancellation.

During formulation, each selected PI will work with NASA to develop top-level science, exploration, technology, and technical performance requirements. Each PI will also work with NASA to establish a set of performance metrics for project evaluation with NASA. These will include cost, schedule, and others, as appropriate.

Once an investigation has been confirmed for implementation, failure of the PI to maintain reasonable progress within committed schedule and cost, and/or failure to operate within the cost and other constraints, may be cause for NASA to convene a termination review. The applicable Associate Administrator may also call for a termination review at any time that an excursion above the agreed upon investigation cost in Phases C through E occurs, or is projected to occur, by the investigation PI, the implementing organization, or NASA. The objective of such a review is to determine whether remedial actions, including changes in management structure and/or key management team members, would better enable the investigation to operate within established cost, schedule, and/or technical constraints. If a termination review determines that no remedy is likely to improve matters, NASA may consider investigation cancellation and/or contract termination.

Every aspect of a selected investigation must reflect a commitment to overall investigation success while controlling total costs. Consequently, investigations should be designed and planned to emphasize investigation success within cost and schedule constraints by incorporating sufficient margins, reserves, and resiliency. Only those investigations whose proposed cost, schedule, and technical requirements do not exceed the constraints and guidelines identified in this AO and the PEA will be considered as candidates for selection.

4.2 Participation Policies

4.2.1 Eligibility to Participate in this AO

Prospective investigators from any category of organizations or institutions, U.S or non-U.S., are welcome to respond to this solicitation. Specific categories of organizations and institutions that are welcome to respond include, but are not limited to, educational, industrial, and not-for-profit organizations, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), NASA Centers, the Jet Propulsion Laboratory (JPL), and other Government agencies.

There is no restriction on the number of proposals that an organization may submit to this solicitation or on the teaming arrangements for any one proposal, including teaming with NASA Centers and JPL. However, each proposal must be a separate, stand-alone, complete document for evaluation purposes.

NASA contracts for the services of outside, non-Governmental organizations for support in evaluating proposals (see Section 7.1). Organizational conflicts of interest between proposing, evaluating, and executing organizations must be avoided. The approach to avoiding organizational conflicts of interest depends on the unique characteristics and roles of each evaluating organization. For non-Governmental organizations, this requires limiting the extent to which the outside evaluating organizations can participate in proposal development and/or execution of the work proposed. NASA has two general classes of limitation for organizations.

Full Limitation: The NASA contract with the outside organization for evaluation support under this AO creates an unmitigatable organizational conflict of interest for the evaluating organization in the event that any business unit of the organization has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, the evaluating organization is precluded from participating in any capacity in support of a respondent under this AO.

Partial Limitation: The NASA contract with the outside organization for evaluation support under this Announcement of Opportunity creates an organizational conflict of interest for the evaluating organization in the event that any business unit of the organization has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, the evaluating organization is precluded from responding to this AO, from participating as a member of any proposal performance team, and from being proposed as the recipient of any work awarded under this AO. Under appropriate circumstances, respondents to this AO may contract with the evaluating organization for supporting analysis services, including cost analysis, engineering analysis, and resource analysis, if it is deemed in the best interest of the Government and only under the following conditions.

- (i) The evaluating organization is precluded from responding to this AO, from participating as a member of any proposal performance team, and from being proposed as the recipient of any work awarded under this AO. The evaluating organization is precluded from providing or developing hardware, including any elements or components, that will be proposed for any work awarded under this AO. The evaluating organization should not be

referenced in the proposal, nor should the evaluating organization's analysis be identified in the proposal.

- (ii) The evaluating organization has established firewalls within the organization to prevent conflicts of interest between organizational units and employees supporting NASA's evaluation of proposals and organizational units and employees supporting proposal efforts. Any supporting analysis services, including supporting cost analysis and supporting engineering analysis, provided to a proposal team must comply with the firewall that has been established by the evaluating organization and is described in a NASA approved Organizational Conflict of Interest Avoidance Plan.
- (iii) The proposer shall fully describe in a memorandum submitted to NASA at the same time as the proposal all of the supporting analysis services provided by the evaluating organization to the proposing team. The memorandum shall not be bound into the proposal itself, but must be a separate document provided by mail or E-mail to the NASA POC identified in the applicable PEA. This memorandum must describe all of the work provided by the evaluating organization, must identify any work products of the evaluating organization that are included in the proposal or its appendices, and must list all employees of the evaluating organization who participated in the work.

For SALMON-2 AO opportunities, two outside evaluating organizations may be used. In this case, their participation in proposed investigations is thus limited, as follows:

- Earth Resources Technology Inc. (ERT) is subject to either the "Full Limitation" described above or to no limitation. The NASA Evaluations, Assessments, Studies, Services, and Support (EASSS) contract with ERT creates an unmitigatable organizational conflict of interest for ERT in the event that any business unit of ERT has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, when ERT is used for support in evaluating proposals, ERT is precluded from participating in any capacity in support of a respondent under this AO. The decision on whether to contract with ERT for support in evaluating proposals will be made at the time of the release of each PEA, and the PEA will include either a full limitation or no limitation for ERT participation in proposal activities.
- The Aerospace Corporation is subject to either the "Partial Limitation" described above or to no limitation. The Aerospace Corporation, as the Federally Funded Research and Development Center (FFRDC) for space systems acquisition, is available to the U.S. Government and other organizations under the terms of its sponsoring agreement with the U.S. Air Force. The Aerospace Corporation has no limitation and is permitted to participate fully in all proposal activities unless a specific PEA states that Aerospace is under a partial limitation for that PEA. If Aerospace is subject to a partial limitation for a specific PEA, respondents to this AO may contract with The Aerospace Corporation for supporting analysis services, including cost analysis, engineering analysis, and resource analysis, only under the conditions described in paragraphs (i), (ii), and (iii) above.

Any other organizations that are used for evaluation services will be identified in the applicable PEA and the applicable PEA will include either a full limitation, a partial limitation, or no limitation, as appropriate.

4.2.2 Restrictions Involving China

Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement.

In accordance with Public Law 112-55, Section 539(a), NASA is restricted from funding any NASA contract, grant, or cooperative agreement action that involves bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement.

Proposals involving bilateral participation, collaboration, or coordination in any way with China or any Chinese-owned company, whether funded or performed under a no-exchange-of-funds arrangement, may be ineligible for award.

4.2.3 Constraints on Investigations that are Candidates for Selection

Only those investigations that propose to meet cost, schedule, and technical requirements that do not exceed the constraints and guidelines identified in this AO and the applicable PEA, and that demonstrate sufficient margins, reserves, and resiliency to ensure mission success within committed cost and schedule will be considered as candidates for selection for flight.

4.2.4 Responsibility of Principal Investigator for Implementation

The primary responsibility for implementing and executing selected investigations rests with the PI, who will have significant latitude to accomplish the proposed objectives within committed schedule and financial constraints. This responsibility will be exercised with essential NASA oversight to ensure that the implementation is responsive to the requirements and constraints defined in this AO and the applicable PEA (see Section 4.1.2).

4.2.5 NASA Concurrence for Replacement of Key Management Team Members

Any replacement of key management team members (including but not limited to the Principal Investigator, Project Manager, Project Scientist, and Project Systems Engineer) requires concurrence from NASA.

4.2.6 Small Business Participation

It is the policy of the Government when contracts are issued to emphasize subcontracting opportunities for small businesses. Offerors are advised that NASA is subject to statutory goals to allocate a fair portion of its contract dollars to small businesses, small disadvantaged business (SDB) concerns, Historically Black Colleges and Universities (HBCUs), and Other Minority Institutions (OMIs), as these entities are defined in FAR 52.219-8 and 52.226-2. Offerors are encouraged to assist NASA in achieving these goals by using best efforts to involve these entities as subcontractors to the fullest extent consistent with efficient performance of their investigations.

Offerors are advised that, by law, for NASA prime contracts resulting from this solicitation which offer subcontracting possibilities, exceed \$650,000, and are with organizations other than small business concerns, the clause at FAR 52.219-9 will apply. Offerors other than small businesses submitting a proposal are advised that a small business subcontracting plan is

required with goals for subcontracting with small business (SB), small disadvantaged business (SDB), veteran-owned small business (VOSB), service-disabled veteran-owned small business (SDVOSB), Historically Underutilized Business Zone (HUBZone) small business (HBZ), women-owned small business (WOSB), HBCU, and OMI entities to the maximum practicable extent. Failure to submit a subcontracting plan will make the offeror ineligible for selection. The subcontracting plans will be evaluated on the participation goals and quality and level of work performed by small business concerns overall, as well as that performed by the various categories of small business concerns listed in FAR 52.219-9.

Proposals are not required to include small business subcontracting plans. These will be required only for selected investigations prior to negotiation and award (Section 7.4.2). Failure to submit a subcontracting plan will make the offeror ineligible for award of a contract. The subcontracting plans will be evaluated on the participation goals and quality and level of work performed by small business concerns overall, as well as that performed by the various categories of small business concerns listed in FAR 52.219-9.

4.3 Cost Policies

4.3.1 *PI-Managed Mission Cost*

PI-Managed Mission Cost is defined as the NASA funding identified in the applicable PEA that the sponsoring Mission Directorate and Program will be expected to provide to the PI's implementation team for the development and execution of the proposed investigation, Phases A through F. It includes any reserves applied to the development and operation of the investigation, as well. It also includes any costs that are required to be accounted against the PI-Managed Mission Cost, even though the PI is not responsible for those costs (*e.g.*, NASA-provided telecommunications and network services described in Section 5.3.6). The PI-Managed Mission Cost may be capped in the applicable PEA.

Examples of costs to be included in the PI-Managed Mission Cost, unless contributed, are: development activities (*e.g.*, instrument development, management, software, testing); E/PO and Student Collaborations in excess of any Student Collaboration incentive (if permitted by the applicable PEA; see Section 5.7.2); subcontracting costs, including fees; Co-Investigators (Co-Is) and all other personnel required to conduct the investigation, analyze data, publish results, and deliver data in an acceptable format to an approved archive; insurance; NASA-provided telecommunications; any program/project-specific costs (*e.g.*, curation of returned samples); and all labor, including contractor and Civil Servant (NASA and non-NASA).

4.3.2 *Total Mission Cost*

Total Mission Cost is defined as the PI-Managed Mission Cost plus optional Student Collaboration costs up to the Student Collaboration incentive (if permitted by the applicable PEA; see Section 5.7.2), plus any additional costs that are contributed or provided in any way other than that identified in the applicable PEA (see Section 5.8). The Total Mission Cost will define the total value of the baseline investigation.

4.3.3 Enhanced PI-Managed Mission Cost

Enhanced PI-Managed Mission Cost is defined as the NASA funding identified in the applicable PEA that will be expected to provide the PI's implementation team for the development and execution of the proposed project, plus any optional components such as Student Collaborations or Science-Exploration-Technology Enhancement Options (if permitted by the applicable PEA; see Section 5.2.5). The Enhanced PI-Managed Mission Cost is the PI-Managed Mission Cost, plus any Student Collaborations up to the Student Collaboration incentive and/or Science-Exploration-Technology Enhancement Options.

4.3.4 Mission Funding Profile

The planning budget described in the applicable PEA can accommodate one or more selections at the cost cap with a typical funding profile over a nominal development period. Proposers should propose a funding profile that is appropriate for their investigation and is consistent with the selection and launch readiness dates identified in the applicable PEA. Cost proposals whose requested funding profile significantly differs from the planning budget for the applicable PEA may be difficult to accommodate and NASA cannot guarantee that the proposed funding profile can be accommodated within the budget. In an extreme case, the inability of NASA to accommodate the requested funding profile may be a reason for nonselection of a proposal. A final funding profile for the selected investigation will be negotiated.

4.3.5 Availability of Appropriated Funds

Prospective proposers to this AO and any applicable PEA are advised that funds are not in general available for awards at the time of its release. The Government's obligation to make awards is contingent upon the availability of sufficient appropriated funds from which payment can be made and the receipt of proposals that NASA determines are acceptable for award under this AO and the applicable PEA.

4.4 Data Policies

4.4.1 Data Analysis

The PI will be responsible for analysis of the investigation data (including returned samples) necessary to complete the proposed objectives and for timely publication of initial results in refereed journals or professional publications, as part of their mission operations (Phase E) or post-mission (Phase F) activities. Data analysis may be continued if applicable during Phase F.

As a condition for confirmation of an investigation that is part of a non-NASA space mission, the organization sponsoring the full mission must make a commitment to enter into an appropriate agreement with NASA HQ that shall include provisions for sharing of flight data necessary for the completion of the selected investigation.

4.4.2 Data Rights

By NASA policy, all data returned from NASA missions, including investigations selected under this AO and the applicable PEA, are immediately in the public domain. A short period of exclusive access may be proposed for data calibration and validation, as described in Section 4.4.3.

4.4.3 Delivery of Data to Archive

Mission data will be made fully available to the public through a NASA-approved archive (*e.g.*, the Planetary Data System, the Atmospheric Data Center, the High Energy Astrophysics Science Archive Research Center, *etc.*), in usable form, in the minimum time necessary, but barring exceptional circumstances, within six months following collection. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to delivery to the archive.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in-flight), documentation, and related software and/or other tools necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that can be used by the scientific community at large.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of the appropriate NASA data archive.

4.5 Project Management Policies

4.5.1 Independent Verification and Validation

The NASA Chief Safety and Mission Assurance Officer has the authority to select software projects to which Independent Verification and Validation (IV&V) is to be applied, as defined in NASA-STD-8739.8, *Standard for Software Assurance*, and NPR 7150.2A, *NASA Software Engineering Requirements*. If the software assurance classification assessment determines IV&V is mandatory, proposal teams are encouraged to contact the Office of the Director at the NASA IV&V Program to gain a preliminary understanding of the potential level of safety and software risks. The Office of the Director can be contacted at 304-367-8200. When a project is required to obtain IV&V, exemption will require an assessment of the software project by the NASA Office of Safety and Mission Assurance (OSMA) and approval by the Chief Safety and Mission Assurance Officer.

4.5.2 Earned Value Management Plan

For government entities, the earned value management (EVM) requirements are listed in NPR 7120.5D NID. For entities receiving contracts, the EVM requirements are listed in NFS 1852.234-2.

4.5.3 Cost Analysis Data Requirement

NASA has established a Cost Analysis Data Requirement (CADRe) in NPR 7120.5D NID, Section 4.5.2.c(3), which will apply to investigations selected through this AO. Support contractors funded directly by NASA Headquarters will perform the actual development of the CADRe; the costs for these services need not be included in the proposed PI-Managed Mission Cost. Selected investigations will have to spend project funds only to collect existing documentations and transmit it to the CADRe support contractor at selected major milestone, and then to review the completed CADRe for completeness and accurately.

4.5.4 Conjunction Assessment Risk Analysis

NASA has established a Conjunction Assessment Risk Analysis (CARA) requirement in NPR 8715.6A, Section 3.4, that will apply to investigations selected through this AO. A CARA team at NASA Goddard Space Flight Center is funded directly by NASA Headquarters to perform the actual analysis and risk assessment; the costs for these services need not be included in the proposed PI-Managed Mission Cost. Selected investigations will have to spend project funds only to establish a working interface between the Flight Operations Team and the CARA team to routinely share orbital ephemerides data and maneuvering plans.

4.6 Launch Service Policies

NASA will not provide launch services through this solicitation unless otherwise stated in the applicable PEA.

4.6.1 Launch Services Risk Mitigation

Payloads classified as Class A, B, or C in accordance with NPR 8705.4 may require the use of NASA procured launch services per NPD 8610.7D, *Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Missions*, and NPD 8610.24C, *Launch Services Program Pre-Launch Readiness Reviews*.

The desired use of a U.S. government furnished or U.S. excess ballistic missile launch vehicle will be formally coordinated with NASA per NPD 8610.7D, NPD 8610.12G, *Space Operations Mission Directorate (SOMD) Space Transportation Services for NASA and NASA-Sponsored Payloads*, and NPD 8610.24C in order to evaluate if the appropriate determination can be made to allow use of a non-commercial U.S. launch vehicle. The planned use of a foreign launch vehicle will also be formally coordinated with NASA per NPD 8610.7D so the appropriate interagency coordination and/or approval actions can be conducted in a timely manner.

4.6.2 Alternative Access to Space

If access to space is not provided in the applicable PEA, proposals may include alternative access to space through provision of non-NASA launch services as a secondary, co-manifested, or hosted payload. Alternative access to space may be either purchased or contributed. Alternative access to space may include spacecraft or payload accommodations on a U.S.- or foreign-manufactured spacecraft launching on a U.S.- or foreign-manufactured launch vehicle.

Access to space for NASA payloads is governed by the U.S. Space Transportation Policy (<http://www.whitehouse.gov/sites/default/files/microsites/ostp/space-transportation-policy-2005.pdf>).

As prescribed in the U.S. Space Transportation Policy (Section V(a)), U.S. Government-sponsored payloads shall be launched on space launch vehicles manufactured in the United States unless exempted by the Director of the Office of Science and Technology Policy, in consultation with the Assistant to the President for National Security Affairs.

- This prescription does not apply to use of foreign launch vehicles on a no-exchange-of-funds basis to support the following: flight of scientific instruments on foreign spacecraft,

international scientific programs, or other cooperative government-to-government programs.

- This prescription also does not apply to the use of foreign launch vehicles to launch U.S. Government secondary scientific payloads for which no U.S. launch service is available.

NASA will support the exemption process, if needed, for selected proposals consistent with U.S. non-proliferation laws and policies. Proposals must clearly state whether an exemption to the U.S. Space Transportation Policy will be necessary.

4.6.3 Coordination with NASA for Rideshare Opportunities

Proposers considering the use of non-NASA launch services as a secondary, co-manifested, or hosted payload should contact the NASA Launch Services Program (LSP) for potential rideshare opportunities and details associated with LSP providing advisory services for launch mission assurance for missions flying as primary or secondary payloads on U.S. or foreign launch vehicles per NPD 8610.7D and NPD 8610.23C, *Launch Vehicle Technical Oversight Policy*.

The LSP point-of-contact for potential rideshare opportunities is Mr. Garrett Skrobot at (321) 867-5365 or by E-mail at garrett.l.skrobot@nasa.gov.

5. Requirements and Constraints

This section provides general requirements on proposals. Supplemental requirements on standard proposal content and format are provided in Appendix B.

5.1 Missions of Opportunity Categories

Although non-U.S. participation is allowed in SALMON-2 investigations, none is required.

5.1.1 Partner Missions of Opportunity

For the purpose of this AO, a PMO is one in which the proposer offers to participate in a non-NASA space mission that is planned or that has been approved by its sponsoring organization. By funding participation in a non-NASA space mission, NASA seeks to provide opportunities for the NASA community to conduct science investigations of interest to NASA as part of a non-NASA space mission. Non-U.S. governments, other U.S. Government agencies, or private sector organizations may sponsor such missions. PMO investigations may be allowed on military satellites or on military space vehicles such as the X-37, provided that the satellites or vehicles are not planned for the purpose of weapons testing.

The PEA will set a cutoff date (the endorsement date) by which NASA endorsement is required by the sponsoring organization. If NASA endorsement is not required by the sponsoring organization by the date listed in the applicable PEA, the proposal should be submitted in response to a future solicitation.

Requirement 3. Proposals for PMOs shall provide a Letter of Commitment from the sponsoring organization stating that the sponsoring organization (i) intends to fund the parent mission, and (ii) that the endorsement of NASA for U.S. PMO participation is required by the sponsoring organization prior to the endorsement date listed in the applicable PEA.

Guidelines and requirements for Letters of Commitment may be found in Section 5.9.2 and Section 5.10.1.

Participation in a non-NASA space mission could take many forms, such as providing a complete instrument, hardware components, technology demonstration, research experiment, or expertise in mission critical areas. Non-hardware mission critical areas include ground systems, pipeline data processing and archiving systems, space navigation and communication capabilities, etc. Contributions to a non-NASA space mission by individual Co-Is, such as participation in instrument design, modeling and simulation of the instrument's operation and measurement performance, calibration of the instrument, scientific analysis and/or research of the data returned, and/or development of innovative data analysis techniques, should be proposed as USPI investigations in response to ROSES or another BAA.

NASA will evaluate the proposed investigation content and feasibility, and not the sponsor's entire mission.

Requirement 4. While the investigator is not required to document the entire mission of the sponsor, proposals for PMOs shall meet the following requirements:

- (i) The proposal shall fully document the complete PMO investigation and how it will be accomplished within the sponsor's mission.
- (ii) The proposal shall identify the mission opportunity or opportunities and must provide evidence in the proposal that the mission provider agrees to manifest the PMO investigation should the proposal be selected and confirmed for flight by NASA.
- (iii) The proposal shall describe the accommodation, including allocations of mass, power, volume, and data (see Requirement B-24 for additional details), demonstrate compatibility with the proposed host mission and show how the host will fulfill the mission requirements. This documentation must be sufficient to allow an evaluation of the adequacy of the sponsor's mission to provide all resources required for a successful investigation.
- (iv) The proposer shall identify and obtain appropriate commitments from the sponsor organization(s) that will provide the payload accommodations.

Note that selection by NASA through this AO does not constitute selection of a PMO investigation as part of the non-NASA mission, which is necessarily a decision made by the sponsor of the mission. Instead, selection is a commitment by NASA to fund the NASA portion of the MO investigation, with funding beyond basic studies not starting until detailed design of the mission itself is underway. If a PMO investigation is selected both by NASA and by the mission sponsor, the PI is fully responsible to NASA for the investigation integrity, as well as the leadership and management, of the NASA contribution to the mission.

Any date constraints, including the timetable for the proposing PI to provide evidence that the sponsoring organization intends to fund the primary host mission and when the NASA commitment for U.S. participation is required by the sponsoring organization, will be listed in the applicable PEA. Unless specified otherwise in the applicable PEA, the launch date itself is not constrained.

PMOs may include flying hardware on a U.S.- or foreign-provided spacecraft launching on a U.S.- or foreign-manufactured launch vehicle. See Section 4.6 for policies and constraints.

NASA investigations are initiated primarily for the conduct and publication of scientific, exploration, and technology research and disseminating those results for the benefit of the U.S. science community. As such, NASA expects that the mission sponsor will enter into an agreement with NASA to assure that data returned from at least those aspects of the mission in which NASA support is involved, if not the entire mission, will be made available to the U.S. research community in a timely way and deposited in an appropriate NASA data archive. NASA will seek to conclude an international agreement with the mission sponsor in advance of launch to ensure that this activity will be performed. NASA recognizes that PMO investigation teams may justifiably incur additional data analysis responsibilities defined by the policies of the sponsor of the parent mission.

Requirement 5. Proposals for PMOs shall demonstrate that the data obtained and the research conducted will benefit the NASA community.

5.1.2 New Missions using Existing Spacecraft

For the purpose of this AO, a PEA may solicit New Missions using Existing Spacecraft (NMESs), defined as an investigation making use of a NASA spacecraft or other working space asset to conduct an investigation that is not a continuation of the spacecraft's original mission.

Requirement 6. Proposals for NMESs shall meet the following requirements:

- (i) The proposal shall make use of a NASA spacecraft or other working space asset once it has completed its prime (and extended) mission(s) or in a complimentary manner that does not interfere with the spacecraft's approved mission.
- (ii) The proposed mission shall constitute a new investigation and may not be an extension, supplement, redirection, augmentation, or follow-up of the spacecraft's original mission or any previously approved mission extensions.
- (iii) The new mission shall constitute an investigation addressing the objectives of the research programs identified in the NASA Strategic Plan and in the applicable PEA.
- (iv) The proposal shall be solely for mission operations, data analysis, and/or ground hardware and not propose any hardware or other modifications to the spacecraft or its prime mission except when new onboard software is required to effect the investigation. In addition, the proposed investigation shall not impose any changes on the requirements of the prime mission

Requirement 7. Proposals for NMESs shall describe how the proposers will transition all aspects of mission operations and data analysis from the current spacecraft mission operations team to the proposed new mission operations team with acceptable risk and with adequate capture of engineering and operations knowledge and lessons learned.

Requirement 8. Proposals for NMESs shall provide evidence that a decision by NASA on whether or not to conduct the proposed new mission extension is required by the date listed in the applicable PEA.

New investigations using research instruments or other technical capabilities currently aboard the International Space Station (ISS) will be considered under this proposal category.

5.1.3 Small Complete Missions

For the purpose of this AO, a PEA may solicit Small Complete Missions (SCMs), defined as complete but small space flight investigations in science, exploration, or technology. In such a case, compelling proposals at any cost within the budget allocation listed in the applicable PEA are permitted. The launch date timetable for proposed SCMs will be listed in the applicable PEA.

The term “complete” encompasses all appropriate mission phases (see Section 5.3.2) from project initiation (Phase A), through all phases of development, mission operations (Phase E), which must include analysis and publication of data in the peer reviewed technical literature, delivery of the data to an appropriate NASA data archive, and closeout (Phase F).

SCMs include access to space. Launch services, if provided, will be described in the applicable PEA. If not provided, proposals must include access to space within the PI-Managed Mission Cost. Proposals for the delivery and use of research instruments or other technical capabilities to the ISS will be considered under the SCM category. SCM investigations may be allowed on military satellites or on military space vehicles such as the X-37, provided that the satellites or vehicles are not planned for the purpose of weapons testing.

Requirement 9. Proposals for SCMs shall meet the following requirements:

- (i) Proposals shall encompass all aspects of the investigation, from initial studies to delivery of data to the appropriate NASA archive, including a complete analysis of data sufficient to accomplish the investigation’s science or technical objectives.
- (ii) Proposals shall describe the development approach for implementing the proposed investigation within schedule and cost constraints, including a project schedule.

If access to space is not provided in the applicable PEA, SCMs may include the provision of non-NASA launch services as primary, secondary, co-manifested, or hosted payloads on a U.S.- or foreign-manufactured launch vehicle.

Requirement 10. Proposals for SCMs that include access to space shall be consistent with U.S. Space Transportation Policy and with the policies in Section 4.6 of this AO and the applicable PEA.

5.1.4 Focused Missions of Opportunity

NASA may enter into strategic arrangements with other space agencies to collaborate on a mission. NASA’s contribution may be a science, exploration, or technology investigation that requires the provision of an instrument, an experiment, hardware components, or software for the other agency’s mission. There may be other circumstances as well, where NASA identifies an opportunity for a space flight investigation and wants to solicit investigations. For the purpose of this AO, such opportunities are called Focused Missions of Opportunity and may be solicited by a specific PEA.

Focused Mission of Opportunity PEAs will fully describe the nature of the opportunity including any schedule, cost, and technical constraints.

5.2 Research Requirements

5.2.1 Scope of Proposed Investigations

A goal is understood to have a broad scope (*e.g.*, discover whether life exists elsewhere in the Universe), while an objective is understood as a more narrowly focused part of a strategy to achieve a goal (*e.g.*, identify specific chemical, mineralogical, or morphological features on Mars that provide evidence of past or present life on that planet).

Requirement 11. Proposals shall describe a science, exploration, or technology investigation with goals and objectives that address the program research objectives identified in the applicable PEA.

Requirement 12. Proposals shall demonstrate how the proposed investigation will fully achieve the proposed objectives.

5.2.2 Traceability of Proposed Investigations

The purpose of the SALMON-2 AO is to provide opportunities for the NASA community to perform focused science, exploration, or technology investigations that culminate with papers published in peer-reviewed archival journals or appropriate professional publications, as well as deposition of appropriately reduced and calibrated data in designated data archives (see Section 4.4.3). Examples of a Science Traceability Matrix and a Mission Traceability Matrix are given in Tables B1 and B2, along with examples for elements in such matrixes. Analogous traceability matrices for exploration and technology proposals are also required.

Requirement 13. Proposals shall clearly state the flow-down from the science, exploration, or technology goals and objectives, to measurement objectives that constitute the baseline investigation, to the data to be returned, and the instrument or experiment complement to be used in obtaining the required data (see Appendix B, Section D, for additional detail).

Requirement 14. Proposals shall include plans to calibrate, analyze, publish, and archive the returned data, and shall demonstrate, analytically or otherwise, that sufficient resources have been allocated to carry out those plans within the proposed investigation cost. The data plans shall discuss and justify any period of exclusive access to the data (see Appendix B, Section E, for further detail).

5.2.3 Investigation Objectives and Requirements

The ability to determine whether a proposed project or experiment can carry out the proposed investigations successfully depends on a crisp, well-formulated articulation of the proposed objectives, the information and steps needed to bring closure to the objectives, and the measurements that must be obtained which conducting the investigation. The proposed investigation is evaluated against the standard of delivering the required measurements successfully.

Requirement 15. Proposals shall state the specific objectives and their required measurements at a level of detail sufficient to assess the capability of the proposed investigation to make those measurements and to determine whether the resulting data will be sufficient to achieve the stated objectives.

Requirement 16. Proposals shall describe the proposed instrumentation or experimental setup, including a discussion of the rationale for its selection.

5.2.4 Baseline and Threshold Investigations

The Baseline Investigation and Threshold Investigation are defined to be consistent with NPR 7120.5D NID as follows:

The “Baseline Investigation” is the investigation that, if fully implemented, would fulfill the Baseline Science/Exploration/Technology Requirements, which are the performance requirements necessary to achieve the full science, exploration, or technology objectives of the investigation.

The “Threshold Investigation” is a descoped Baseline Investigation that would fulfill the Threshold Science/Exploration/Technology Requirements, which are the performance requirements necessary to achieve the minimum science, exploration, or technology acceptable for the investment.

The differences between the Baseline Investigation and the Threshold Investigation provide resiliency to potential cost and schedule growth in the proposed development and implementation plan. A descope is an alteration of an investigation that renders it unable to accomplish one or more of the Baseline Investigation objectives, but allows accomplishment of all Threshold Investigation objectives.

NASA recognizes that, in some circumstances, the Threshold Investigation may be identical to the Baseline Investigation.

Requirement 17. Proposals shall specify only one Baseline Investigation and only one Threshold Investigation.

Requirement 18. Proposals shall not include any descopes or other risk mitigation actions that result in the mission being unable to achieve the Threshold Investigation objectives.

5.2.5 Science-Exploration-Technology Enhancement Options

Activities such as extended missions, guest investigator programs, general observer programs, participating scientist programs, interdisciplinary scientist programs, and/or archival data analysis programs, where appropriate, have the potential to broaden the scientific impact of investigations. Such optional activities may be included as Science-Exploration-Technology Enhancement Options (SEOs) for investigations proposed in response to a PEA.

NASA considers any proposed SEO activities as optional. Inclusion of such optional activities in a proposal does not imply a commitment from NASA to fund them, even if the baseline

investigation is selected. NASA reserves the right to accept or decline proposed SEO activities at any time during the investigation; in particular, the decision may not be made at the time the baseline investigation is selected for flight. The process for deciding on SEO activities may involve further reviews (e.g., a “Senior Review” for extended missions). NASA reserves the right to solicit and select all participants (e.g., guest investigators, archival data analysts, and participating scientists) in such programs.

Costs for proposed SEO activities must be defined, but will not count against the PI-Managed Mission Cost cap. Funding requested for SEO activities prior to Phase E should be minimized. As these proposed activities are optional and are not included within the cost capped baseline investigation, the science enabled by SEO activities is not considered as part of the scientific/exploration/technology merit of the proposed investigation.

Requirement 19. If SEO activities are proposed, the proposal shall define and describe the proposed activities and their costs.

Requirement 20. If SEO activities are proposed, they shall be clearly separable from the Baseline Investigation and Threshold Investigation.

Requirement 21. If an extended mission SEO is proposed for SMD-sponsored solicitations, it shall conform to the guidelines provided in the *SMD Mission Extension Paradigm* document found in the PEA-specific Program Library.

See Appendix B, Section E, for additional detail.

5.3 Technical Requirements

5.3.1 Commitment for a Single Step Selection

Unless stated otherwise in the applicable PEA, proposed investigations will be evaluated and selected through a single step competitive process.

Requirement 22. Each proposal must include a commitment by the PI for the cost, schedule, and scientific, exploration, and technical performance of the investigation.

5.3.2 Complete Mission Investigations

Proposals must encompass all aspects of an investigation, from initial studies to delivery of the data to the appropriate NASA data archive, including a complete analysis of the data sufficient to accomplish the investigation’s science, exploration, or technology objectives. NPR 7120.5D NID defines the activities, milestones, and products typically associated with each mission phase, and shall be used as a guideline when defining a mission approach. Note that NPR 7120.5D NID levies requirements on projects, not proposals. Investigations must be proposed at an appropriate risk classification per NPR 8705.4, *Risk Classification for NASA Payloads*.

Requirement 23. Unless specified otherwise in the applicable PEA, proposers shall propose a mission categorization and payload risk classification for their proposed mission based on the

criteria for mission categorization in NPR 7120.5D NID and risk classification in NPR 8705.4. Proposers shall incorporate appropriate work effort and support in their proposals accordingly.

Investigations that intend to propose cost savings by defining PI roles or responsibilities that differ from the standard program requirements may require waivers; any such waiver requests must be explicitly identified in the proposal and will require approval.

The designated Program Office will be responsible for monitoring the PI's progress and will maintain sufficient insight into the development activities to ensure that cost, schedule, and technical performance of the investigation remains within established boundaries. Investigation teams shall abide by all applicable NASA and other Federal, state, and local laws and regulations.

The baseline investigation proposed in response to this AO and the applicable PEA must be complete from project initiation through closeout. This baseline investigation must contain, within the PI-Managed Mission Cost, all mission activities required to accomplish the proposed goals and objectives.

Requirement 24. Proposals submitted in response to this AO and the applicable PEA shall be for complete research investigations that require a spacecraft mission.

The applicable PEA might broaden the allowable platforms beyond spacecraft to include other platforms such as suborbital platforms.

Requirement 25. Proposals shall encompass all aspects of the investigation, from initial studies to delivery of data to the appropriate NASA archive, including a complete analysis of data sufficiency to accomplish the investigation's research or technical objectives

This AO solicits investigations that can be executed within the scope of the PI-Managed Mission Cost Cap and/or other cost constraints given in the applicable PEA.

Requirement 26. Proposals shall describe the development approach for implementing the proposed investigation within schedule and cost constraints, including a project schedule.

For small complete missions, see Appendix B, Section F (Version B), for details. For other categories of SALMON investigations, see Appendix B, Appendix F (Version A).

5.3.3 Accepted Management Processes and Practices

The document NPR 7120.5D NID, *NASA Space Flight Program and Project Management Processes and Requirements*, delineates activities, milestones, and products typically associated with Formulation and Implementation of projects; it should be used as a reference in defining an Investigation Team's management approach. The implementing organizations are free to propose their own processes, procedures, and methods for managing their missions; however, they must be consistent with the principles of NPR 7120.5D NID. Processes, procedures, and methods should be proposed that are appropriate for the scope and scale of the proposed investigation.

Deviations from, and tailoring of, NPR 7120.5D NID can be proposed but will require a waiver during formulation⁴.

Requirement 27. Proposals shall describe the investigation's proposed management approach, including the management organization and decision-making process, the teaming arrangement, the responsibilities of the PI and other team members, and the risk management and risk mitigation plans (see Appendix B, Section G, for additional detail).

The document NPR 7123.1A, *NASA Systems Engineering Processes and Requirements*, clearly articulates and establishes the requirements on the implementing organization for performing, supporting, and evaluating systems engineering. This systems approach is applied to all elements of a system and all hierarchical levels of a system over the complete project life cycle. NPR 7123.1A should be used in defining the Investigation Team's systems engineering approach. The implementing organizations are free to propose their own processes, procedures, and methods for systems engineering; however, they must be consistent with NPR 7123.1A.

Requirement 28. Proposals shall describe the investigation's proposed systems engineering approach, including plans, tools, and processes for requirements, interfaces, and configuration management.

Requirement 29. Proposals shall describe any deviations from NPR 7120.5D NID, NPR 7123.1A, and any other NASA procedural requirements that will require a waiver during formulation.

See Appendix B, Section F, for additional details.

5.3.4 New Technologies/Advanced Developments

The PEA may specify that it solicits science or exploration investigations, not technology development projects. Proposed science or exploration investigations are generally expected to have mature technologies, specifically all technologies at a Technology Readiness Level (TRL) of 6 or higher (TRLs are defined in Appendix J of NPR 7120.8, *NASA Research and Technology Program and Project Management Requirements*). Proposals with less mature technologies are permitted as long as they contain a plan for maturing all technologies to TRL 6 no later than KDP-C (Confirmation) and adequate backup plans in the event that the technologies cannot be matured as planned.

PEAs issued by OCT, including those that solicit a technology demonstration investigation as opposed to a science or exploration investigation, will require technologies to be matured to TRL-5, not TRL-6, no later than KDP-C (Confirmation). Requirement 30 is not applicable to such PEAS.

Requirement 30. Unless otherwise specified in the applicable PEA, proposals that use technologies currently at less than TRL 6 shall include a plan for technology maturation to

⁴ The currently active version of NPR 7120.5D NID, as of October 3, 2011, is document number NM 7120-97.

TRL 6 no later than KDP-C and a backup plan in the event that the technologies cannot be matured as planned.

See Appendix B, Section F, for additional details.

5.3.5 Launch Services

NASA will not provide launch services through this solicitation unless otherwise stated in the applicable PEA.

Requirement 31. Proposals that include launch services that are not provided by NASA, but are obtained from or provided by a U.S. or non-U.S. partner, shall meet the following requirements:

- (i) The proposer must secure the organization(s) that will provide launch services.
- (ii) The proposal must demonstrate that the proposed launch services are consistent with the U.S. Space Transportation Policy and the policies in Section 4.6.2.
- (iii) The proposal must identify the launch opportunity and must provide evidence in the proposal that the launch service provider agrees to manifest the investigation should the investigation be selected and confirmed for flight by NASA.
- (iv) The proposal must describe the launch services, demonstrate compatibility with the proposed launch vehicle, and show how the provider will fulfill the mission requirements.
- (v) The proposal must describe the approach for NASA's insight for launch services consistent with the policies in Section 4.6.1.

The applicable PEA will indicate whether the proposal budget must include a charge for NASA launch vehicle monitoring functions and advisory services.

See Appendix B, Section F, for additional details.

5.3.6 Telecommunications, Tracking, and Navigation

Use of NASA's Near-Earth Network (NEN), Space Network (SN), or Deep Space Network (DSN) may be proposed, as appropriate. Points of contact and cost information for these services may be found in the *NASA's Mission Operations and Communications Services* document in the PEA-specific Program Library.

A cost estimation algorithm for the DSN and persons to contact to obtain costs for other networks and various Government operated facilities are contained in the *NASA's Mission Operations and Communications Services* document or at the DSN Future Missions Planning Office website at <http://deepspace.jpl.nasa.gov/advmiss/>. For assistance with the cost calculation, contact the persons named on the website.

However, proposers are free to propose the use of services from sources other than those offered through NASA. When the use of non-NASA communication services is proposed, NASA reserves the option of contracting for those services directly through its Space Communication and Navigation (SCaN) office. Information on SCaN may be found at <https://www.spacecomm.nasa.gov/spacecomm/>. Further information can be obtained from the point of contact in the *NASA's Mission Operations and Communications Services* document.

NASA funds may not be used for the construction of new facilities for non-NASA communications services.

In addition, the NASA Integrated Services Network (NISN) can provide secure circuits from NASA Centers to mission and science operations centers located at universities and other non-NASA locations. Traditional spacecraft operations services such as command generation, telemetry processing, mission scheduling, orbit and attitude determination, spacecraft engineering data evaluation, and trending are also available through capabilities existing at Goddard Space Flight Center (GSFC) and JPL.

If required, costs for such services, whether obtained from NASA or other sources, shall be included in the PI-Managed Mission Cost. Investigations shall conduct trade studies on the use of NASA-provided services versus any proposed alternatives after selection, but shall conduct such studies no later than Phase B. NASA-provided services shall be employed whenever they meet objectives at a life-cycle cost to NASA that is less than or equal to any proposed alternatives.

As appropriate, SCaN will assist proposers in identifying SCaN services, prices, and cost trades. If the sponsoring NASA Mission Directorate and SCaN agree that the proposed approach does not result in the lowest life-cycle cost, the sponsoring NASA Mission Directorate may direct the investigation to modify its approach. Information on NASA-provided mission operation capabilities, including SCaN space communications services and costing, is given in the *NASA's Mission Operations and Communications Services* document.

Requirement 32. Proposals shall include mission requirements for telecommunications, tracking, and navigation; proposals shall also include a plan for meeting those requirements, including a cost plan, where the cost of development and use of telecommunications, tracking, and navigation services must be included within the PI-Managed Mission Cost whether or not NASA networks are used. For PMOs and hosted payloads, where the PI is not responsible for the host mission, proposals shall describe the investigation's requirements for telecommunications, tracking, and navigation, and the proposal shall describe how the host mission will meet those requirements.

Requirement 33. If use of NASA's network services is proposed, costs for services, as described in the *NASA's Mission Operations and Communications Services* document, must be included in the proposal's cost plan

Where the use of NASA's network services is clearly within the capabilities and capacities described in the *NASA's Mission Operations and Communications Services* document, no Letter of Commitment is required from the NASA network provider.

Where the use of NASA's network services may not be within the capabilities and capacities described in the *NASA's Mission Operations and Communications Services* document, discussions should be initiated with the Point of Contact (POC) named in that document. In this case, a Letter of Commitment is required from the NASA network provider describing the network's ability to deliver the required capabilities and capacities and the cost for doing so.

Requirement 34. If use of NASA's network services beyond the capabilities and capacities described in the *NASA's Mission Operations and Communications Services* document is proposed, the proposal shall include a Letter of Commitment from the NASA network provider; the Letter shall confirm the ability of the network to provide the required capabilities and capacities and should include an estimate of the additional costs for these capabilities and capacities.

5.3.7 Critical Event Coverage

Critical events in the operation of a spacecraft are defined as those that must be executed successfully, usually in a single opportunity, as failure could lead to early loss or significant degradation of the mission if not executed successfully or recovered from quickly in the event of a problem.

NPR 8705.4, *Risk Classification for NASA Payloads*, requires that critical event telemetry be recovered for reconstruction of an anomaly, should one occur. Telemetry coverage is required during all mission critical events to assure data is available for critical anomaly investigations to prevent future recurrence. Critical events telemetry does not need to be available in real time to operators, but if telemetry is stored and forwarded then it must be stored somewhere other than the flight element from where it was generated. NPR 8705.4 provides examples of critical events. Critical event coverage may be provided in any fashion that is deemed appropriate for the proposed investigation.

Requirement 35. Proposals shall specify all critical events for the proposed mission, and shall discuss the technical approach, required resources, and implementation concepts for providing critical event telemetry. This requirement does not apply to PMOs and hosted payloads, where the PI is not responsible for the host mission.

5.3.8 Environmental Review and Launch Approval

The *National Environmental Policy Act (NEPA) of 1969*, as amended (42 USC 4321 *et seq.*) is the nation's policy for the protection, maintenance, and enhancement of the environment. It requires NASA decision-makers to take environmental factors into account during the decision making process. NASA is required to comply with NEPA for activities involving research and development, space flight activities, and program management. NASA implements NEPA using 14 Part 1216.3, *Procedures for Implementing the National Environmental Policy Act*, NPR 8580.1, *Implementing the National Environmental Policy Act and Executive Order 12114*, and the Council on Environmental Quality (CEQ) *Regulations for Implementing the Procedural Provisions of NEPA* (40 CFR Parts 1500-1508).

NASA is responsible for determining the proper level of NEPA and related documentation required for a mission and ensuring that the process is completed during the preliminary design and technology development phase of a mission (per NPR 7120.5D NID). Depending on the potential environmental impacts of a selected mission, one of three levels of NEPA documentation will be required:

- Record of Environmental Consideration and a NASA Routine Payload (NRP) Checklist;
- Preparation of a mission unique Environmental Assessment (EA); or

- Preparation of a mission unique Environmental Impact Statement (EIS).

Launch approval processes generally carry an estimated cost of \$100K for routine NASA payload environmental assessment and \$500K for non-routine NASA payload environmental assessment.

Requirement 36. For NASA launches, the costs of environmental review and launch approval shall be included in the PI-Managed Mission Cost. The key milestones for environmental review and launch approval shall be accounted for in the proposed schedule.

Questions concerning environmental review requirements or NEPA may be addressed to Ms. Tina Norwood, the NASA NEPA Program Manager, at (202) 358-7324 or by E-mail at nepa@hq.nasa.gov.

5.3.9 Use of Radioactive Material

The PEA may state that the proposed use of radioactive materials of any quantity and any isotope, including radioisotope power sources, radioisotope heater units, or radioactive calibration sources for science instruments, is not permitted.

Alternatively, a PEA may allow for investigations to baseline use of small amounts of radioactive material for uses such as radiological calibration sources for science instrumentation; however no radioactive material may be used for supplemental power.

The proposed use of radioactive materials of any quantity and any isotope, including radioactive calibration sources for science instruments, will require review for environmental impact and nuclear launch safety approval (NLSA). The environmental review requirements flow from the *National Environmental Policy Act* (NEPA) and are specified in NPR 8580.1, *Implementing the National Environmental Policy Act and Executive Order 12114*. The NLSA requirements are specified in NPR 8715.3, *NASA General Safety Program Requirements*, Chapter 6: “Nuclear Safety for Launching of Radioactive Materials.” The effort required for NLSA consists of concurrence from the NASA Office of Safety and Mission Assurance for low-level radioactive sources (*i.e.*, with an A2 mission multiple less than 10, as defined in NPR 8715.3, Chapter 6 and Appendix D).

Requirement 37. If use of radioactive materials is proposed for radiological calibration sources, the proposal shall include a listing of the estimated radioactive materials to be used (isotope, form, quantity). The proposal shall provide a rationale for the use of radioactive materials and reasonable, non-nuclear alternatives.

Requirement 38. For NASA launches involving the use of radioactive materials, the costs of environmental review and launch approval shall be included in the PI-Managed Mission Cost. The key milestones for environmental review and launch approval shall be accounted for in the proposed schedule.

Questions concerning the NLSA process may be addressed to the Nuclear Flight Safety Assurance Manager, Mr. John W. Lyver IV, Office of Safety and Mission Assurance, at 202-358-1155 or by E-mail at jlyver@nasa.gov.

5.3.10 End-of-Mission Spacecraft Disposal

NPR 8715.6A, *NASA Procedural Requirements for Limiting Orbital Debris*, specifies that spacecraft are to limit the generation of orbital debris during operations and spacecraft disposal requirements for all Earth- and Moon-orbiting spacecraft. Earth-orbiting spacecraft must be passivated at the end of the mission prior to disposal and be deorbited within 25 years of end-of-mission (or 30 years after launch, whichever comes first), or be placed in a disposal orbit above 2000 km but not within 300 km of geosynchronous orbit (GEO).

For PMOs and hosted payloads, where the PI is not responsible for the host mission, information shall be included regarding the instrument's contributions to orbital debris and how the instrument will be passivated at end-of-mission. This will allow NASA to remain in compliance with NPR 8715.6A, *NASA Procedural Requirements for Limiting Orbital Debris*.

Requirement 39. As applicable for Earth and Moon orbiters, any proposal for an investigation that is subject to the requirements in NPR 8715.6A shall demonstrate satisfaction of the orbit disposal requirement by providing a mission lifetime analysis and indicating whether disposal is in orbit or with a reentry, either controlled or uncontrolled (see Appendix B, Section J.7, for additional detail). For PMOs and hosted payloads, where the PI is not responsible for the host mission, information shall be included regarding the instrument's contributions to orbital debris and how the instrument will be passivated at end-of-mission.

5.4 Management Requirements

5.4.1 Principal Investigator

The Principal Investigator (PI) is accountable to NASA for the success of the scientific, exploration, or technology investigation, with full responsibility for its scientific, exploration, or technology and technical integrity, and for its execution within committed cost and schedule.

Designation of a Deputy PI is recommended but not required.

The PI must be prepared to recommend termination of the investigation when, in her/his judgment, the minimum objectives, identified in the proposal as the Threshold Investigation, is not likely to be achievable within the committed cost and schedule.

Requirement 40. Proposals shall identify and designate one, and only one, PI as the individual in charge of the proposed investigation.

5.4.2 Project Manager

All PI-led investigations must have a qualified Project Manager (PM). The PM oversees the technical and programmatic implementation of the project. The PM works closely with the PI in order to ensure that the mission meets its objectives within the resources outlined in the proposal.

Proposals may designate a Project Manager Alternate. At selection and subject to the approval of NASA, the Alternate may be named as the Project Manager. The qualifications of both the PM and the PM Alternate will be evaluated.

NASA will approve the PM at each transition to the next Phase of implementation as part of the KDP approval process.

Requirement 41. Proposals shall identify a single Project Manager as the individual charged with the responsibility for overseeing the technical and programmatic implementation of the proposed project. Proposals may optionally name a single Project Manager Alternate.

Requirement 42. Proposals shall clearly define the respective roles of the PI and PM.

5.4.3 Management and Organization Experience and Expertise

The qualifications and experience of the PI, PM, Project Scientist (PS), Project Systems Engineer (PSE), Project Manager Alternate (if named), and other key members of the PI-led Investigation Team must be commensurate with the technical and managerial needs of the proposed investigation.

The implementing institutions, selected and overseen by the PI, have the responsibility to ensure that the mission meets schedule and cost constraints. It is the PM and the implementing institutions' responsibility to provide the quality personnel and resources necessary to meet the technical and managerial needs of the mission. The commitment, spaceflight experience, and prior experience of the key members of the PI-led investigation team and of the implementing institutions will be assessed against the needs of the investigation.

Requirement 43. Proposals shall identify the management positions that will be filled by key management team members. These positions shall include, at minimum, the PI, PM, PSE, Project Manager Alternate (if named) and, where appropriate, the PS and partner leads, especially partner leads for substantial efforts. For management positions, for which key management team members are named (including the PI and PM per Requirements 32 and 33), proposals shall describe the qualifications and experience required of any candidate to occupy those positions. For all positions that will be filled by key management team members, proposals shall demonstrate that the described qualifications and experience are commensurate with the technical and managerial needs of the proposed investigation.

Requirement 44. Proposals shall describe the qualifications and experience of the primary implementing institutions and demonstrate that they are commensurate with the technical and managerial needs of the proposed investigation.

Requirement 45. For large or complex efforts involving interactions among numerous individuals or other organizations, the proposal shall describe plans for distribution of responsibilities and arrangements for ensuring coordinated efforts.

See Appendix B, Section G, for additional detail.

5.4.4 Risk Management

Proposers must demonstrate clear understanding of specific risks inherent in the formulation and implementation of their proposed investigation and must discuss their approaches to mitigating these risks. Examples of such risks that must be discussed in the proposal are: any new technologies, or any nontrivial modifications or upgrades of existing technologies, proposed for the investigation; any validation of heritage technology for the mission context; any manufacturing, test, or other facilities needed to ensure successful completion of the proposed investigation; any need for long-lead items that must be placed on contract before the beginning of Phase C to ensure timely delivery; and any contributions that are critical to the success of the mission.

Requirement 46. Proposals shall define and discuss the major risks to the formulation and implementation of the proposed investigation.

Requirement 47. Proposals shall discuss management approaches to mitigate risks to ensure successful achievement of the investigation objectives within the committed cost and schedule.

The differences between the Baseline Investigation and the Threshold Investigation (see Section 5.2.4) may provide some resiliency to potential cost and/or schedule growth in the proposed formulation and implementation of the investigation. One method of responding to such growth is to descope the mission. Any set of descopes, which still allows the investigation to satisfy the objectives of the Threshold Science Mission, may be proposed.

Requirement 48. If the proposed risk management approach includes potential descoping of mission capabilities, the proposal shall include a discussion of the approach to such descopes, including savings of resources (mass, power, schedule, funding, *etc.*) by implementing descopes and the decision milestone(s) for implementing descopes.

Requirement 49. Proposals that include international participation shall address the risk resulting from any international contributions to the proposed mission (see Section 5.8 and Section 5.9).

5.4.5 Schedule

Requirement 50. Proposals shall conform to the schedule requirements provided in the applicable PEA.

5.4.6 Compliance with Procurement Regulations by NASA PI Proposals

Proposals submitted by NASA Centers are required to comply with regulations governing proposals submitted by NASA PIs (NFS 1872.308). Additional instructions can be found in PIC 05-15, available at <http://www.hq.nasa.gov/office/procurement/regs/pic.html>.

Requirement 51. Proposals submitted by NASA Centers shall contain any descriptions, justifications, representations, indications, statements, and/or explanations that NFS 1872.308 requires.

See Appendix B, Section J.6, for additional details.

5.5 Cost Requirements

5.5.1 PI-Managed Mission Cost and Total Mission Cost

The applicable PEA states the funding cap or other cost constraints for the PI-Managed Mission Cost, including all mission phases (see Section 4.3).

For each selection, and unless otherwise stated in the selection letter, the selected investigation's cost cap will be set at the proposed PI-Managed Mission Cost.

Requirement 52. Proposals shall include the proposed PI-Managed Mission Cost and the proposed Total Mission Cost in all required AO cost tables (see Appendix B, Section H, for required AO cost tables).

Requirement 53. The proposed costs shall comply with the PI-Managed Mission Cost cap or other cost constraints stated in the applicable PEA.

Requirement 54. No more than 25% of the proposed costs may be incurred prior to KDP-C (Confirmation).

For Partner Missions of Opportunity, it is important to understand that the PI assumes all risk for delays in the implementation of the parent mission and shall, therefore, propose appropriate reserves for such schedule contingencies. Following the completion of Phase A, but prior to final selection by the parent mission's sponsoring organization, and unless specified otherwise in the PEA, NASA funding for additional work will be limited to \$100K/year.

5.5.2 Cost Estimating Methodologies and Cost Reserve Management

As the provision of cost details is not anticipated until later in formulation, proposals may use estimates derived from models or cost estimating relationships from analogous missions (see Appendix B, Section H, for additional details).

Requirement 55. Proposals shall identify the methodologies (cost models, cost estimating relationships of analogous missions, etc.) and rationale used to develop the proposed cost.

Requirement 56. Proposals shall include a discussion of sources of estimating error and uncertainty in the proposed cost and management approaches for controlling cost growth.

Proposals that are unable to show adequate development unencumbered cost reserves are likely to be judged a high cost risk and not selected. For the purpose of this AO, the development unencumbered cost reserves on the PI-Managed Mission Cost are measured as a percentage against the cost to complete through Phases A/B/C/D. The numerator is the amount of development unencumbered cost reserves for Phases A/B/C/D, not including funded schedule reserve. The denominator is the PI-Managed Mission Cost to complete development Phases A/B/C/D, including the cost of technical design margin, including funded schedule reserve, not including cost reserve.

Adequate development unencumbered cost reserves for Phases A/B/C/D is defined to be a minimum of 25%. Instruments and international collaborations often require higher reserves than the minimum. Adequate unencumbered cost reserves must be demonstrated at each of the following milestones: KDP-A (demonstrated in the proposal), KDP-B, KDP-C (the independent cost estimate for Confirmation), and KDP-D (at the end of Phase C).

Requirement 57. Proposals shall justify the adequacy of the proposed cost reserves, given that the proposed cost is not allowed to increase beyond the cost cap; it is not sufficient to simply propose the minimum required cost reserves with justification that this level of reserves is adequate. Proposals shall comply with the requirement for unencumbered cost reserves against the development cost to complete and shall demonstrate an approach to maintaining required development unencumbered cost reserves through subsequent development and operations phases.

Requirement 58. Although minimum unencumbered cost reserves are not specified in this AO for Phases E and F, proposals shall establish, identify and justify adequate reserves for these phases of the mission.

5.5.3 Work Breakdown Structure

Requirement 59. Proposals shall provide a Work Breakdown Structure (WBS) that conforms to the standard prescribed in Appendix G of NPR 7120.5D NID. Costs for all elements shall be specified to WBS Level-2 with the following exceptions. Exceptions are the costs of elements which explicitly appear only at a level below WBS Level-2; these exceptions include individual instruments, unique flight system elements, the use of NASA or NASA-procured tracking and communications, and data analysis/archiving (see Appendix B, Section H, for additional details).

5.5.4 Master Equipment List

Requirement 60. Proposals shall include a Master Equipment List (MEL) summarizing all flight element subsystem components and individual instrument element components to support validation of proposed mass estimates, design heritage, and cost (see Appendix B, Section J.8, for additional details).

5.5.5 Full Cost Accounting for NASA Facilities and Personnel

For the purpose of calculating the full cost of NASA provided services for proposals submitted in response to this AO, proposal budgets from NASA Centers, whether as the proposing organization or as a supporting organization, are to include within the PI-Managed Mission Cost all costs required for the performance of the research effort. Even if the NASA civil servant labor and benefits costs will be covered by a civil service labor and expense account so that these costs will not be paid from the resulting award, they still must be accounted for within the PI-Managed Mission Cost.

All NASA civil servant labor costs, including salary and benefit costs, must be clearly identified by year within the budget justification section of the proposal.

Estimated NASA Center Management and Operations (CM&O) costs must be included to enable a level playing field for all proposers. For the purpose of calculating the full cost of NASA

provided services for proposals submitted in response to this AO, the CM&O burden should be applied only to NASA provided labor, including Center civil servants and on-site contractors.

Do not include within the cost proposal, nor within the PI-Managed Mission Cost, other costs not paid with Program funds such as allocated service pools, Agency Management and Operations (AM&O, a.k.a. NASA Headquarters overhead), and any CM&O burden attributed to off-site contracts (pass-through dollars) and other cost elements.

Proposal budgets from NASA Centers, whether as the proposing organization or as a supporting organization, must include within the PI-Managed Mission Cost the following cost elements as appropriate and must separately identify them by element and by year:

- NASA civil servant direct labor including benefits;
- NASA civil servant travel;
- Other direct costs including non-civil servant demand service pools and procurements as identified in the NASA N-2 database; and
- The CM&O burden on NASA provided labor, including Center civil servants and on-site contractors.

NASA Centers should use the CM&O rate specified in the most recent Agency Strategic Programming Guidance (SPG) issued by the Office of the Chief Financial Officer (OCFO).

Table 5.5.5-1: Cost Elements for NASA Center Budget Proposals in response to SALMON-2

	Identify in proposal	Include in PI-managed mission cost	Funding source	Comments
Civil Service Labor	Yes	Yes	Mission Directorate (MD) Program	includes benefits
Civil Service Travel	Yes	Yes	MD Program	
Other Direct	Yes	Yes	MD Program	includes non-civil servant demand service pools and procurements as identified in the NASA N-2 database
CM&O	Yes	Yes	CASP	applied to NASA provided labor, including Center civil servants and on-site contractors
AM&O	No	No	CASP	includes NASA provided independent technical authority
NASA Contributed Costs	Yes	No	Identify	must be non-MD
Non-NASA Federal Government Costs (funding requested from NASA)	Yes	Yes	MD Program	if NASA funding is requested for the non-NASA Federal Government agency

Contributions	Yes	No	Identify	includes all non-NASA contributions
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Requirement 61. Proposals that include costs for NASA Centers shall conform to the full cost policy stated in Section 5.5.5. Each element of the NASA Center costs (direct labor, travel, other direct costs (procurements and demand service pools), CM&O) shall be separately identified by year.

If any NASA funded item(s) or services are to be considered as contributed costs, then the contributed item(s) must be separately funded by an effort complementary to the proposed investigation, the value of the contribution(s) must be estimated, and the funding source(s) must be identified. For SMD-sponsored solicitations, the complementary effort must not be within SMD.

Requirement 62. If any NASA funded item(s) or services are considered as contributed costs, then the proposal shall estimate the value of the contribution(s) and shall identify the funding source(s).

Any non-NASA Federal Government costs must follow the appropriate agency accounting standards for full cost. If no standards are in effect, the proposers must follow the *Managerial Cost Accounting Concepts and Standards for the Federal Government*, as recommended by the Federal Accounting Standards Advisory Board and available at http://www.fasab.gov/pdffiles/handbook_sffas_4.pdf.

Requirement 63. Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

5.6 Investigation Team, Co-Investigators, and Collaborators

5.6.1 Investigation Team

Requirement 64. Proposals shall clearly define the team necessary to conduct the investigation successfully.

5.6.2 Co-Investigators

A Co-Investigator (Co-I) is defined as an investigator who plays a necessary role in the proposed investigation and whose services are either funded by NASA or are contributed by his/her employer.

Every Co-I must have a role that is required for the successful implementation of the investigation, and the necessity of that role must be justified. The identification of any unjustified Co-Is may result in the downgrading of a proposal and/or the offer of only a partial selection by NASA.

Requirement 65. Proposals shall designate all Co-Is, describe the role of each Co-I in the development of the investigation, and justify the necessary nature of the role.

Requirement 66. Proposals shall identify the funding source for each Co-I. If funded by NASA, costs shall be included in the PI-Managed Mission Cost (Section 4.3.1). If contributed, the costs shall be included in the Total Mission Cost (Section 4.3.2).

5.6.3 Collaborators

A collaborator is an individual who is less critical to the successful development of the investigation than a Co-I. A collaborator must not be funded through the proposal. A collaborator may be committed to provide a focused contribution to the project for a specific task, such as data analysis. If funding support is requested in the proposal for an individual, that individual must not be identified as a collaborator, but must be identified as a Co-Investigator or another category of team member.

Requirement 67. Proposals shall identify and designate all collaborators.

5.7 Education and Public Outreach

5.7.1 Core E/PO Program

Among NASA's strategic goals is to communicate the results of its efforts to the American public and to enhance the science, technology, engineering, and mathematics education of the next generation of Americans. The PEA may state that selected investigations will be required to implement a core Education and Public Outreach (E/PO) program. However the quality of E/PO plans is not a consideration in the selection of proposals. Therefore, E/PO plans are not needed at this time. Detailed plans for E/PO programs are neither required nor permitted in proposals.

For SMD sponsored investigations, the PEA will require a program that is consistent with SMD policy (see the *Explanatory Guide to the NASA Science Mission Directorate Educational and Public Outreach Evaluation Factors*). A selected SMD investigation will develop a plan for a core E/PO program during formulation compliant with SMD Policy Document SPD-18, *Policy and Requirements for the E/PO Programs of SMD Missions*. The minimum allowable core E/PO program cost is defined to be 1% of the PI-Managed Mission Cost Cap. Investigations must designate at least the minimum allowable core E/PO program cost for implementation of the core E/PO program. There is no maximum allowable cost for the core E/PO program; however, the funding for the core E/PO program must be included in the PI-Managed Mission Cost. Core E/PO activities may continue for one year following end-of-prime-mission to allow for the incorporation of the results of the mission investigation into the core E/PO program. The documents are available in the PEA-specific Program Library.

Additional E/PO guidance may be provided in the applicable PEA for non-SMD sponsored investigations.

Requirement 68. Proposals shall not designate an E/PO lead and shall not include a plan for a core E/PO program.

Requirement 69. If the PEA requires an E/PO program for selected investigations, proposals shall identify the funding set aside for the implementation of a core E/PO program; this funding

shall be at least the minimum allowable core E/PO program cost and shall be included in the PI-Managed Mission Cost.

Requirement 70. If the PEA requires an E/PO program, and unless specified otherwise in the PEA, proposals shall include the following statement of commitment from the PI (see Appendix B, Section I.2, for additional details):

“I understand the NASA requirements for E/PO and I am committed to carrying out a core E/PO program that meets the goals described in the *Explanatory Guide to the NASA Science Mission Directorate Educational and Public Outreach Evaluation Factors* document. I will submit a preliminary E/PO plan no later than KDP-B if this proposal is selected.”

5.7.2 Student Collaborations (optional)

The applicable PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. A SC can take the form of an instrument development, an investigation of scientific questions, analysis and display of data, development of supporting hardware or software, or other aspects of the investigation. The SC must be incorporated into the mission on a nonimpact basis. That is, the SC may not increase the mission development risk or impact the development or performance of the baseline science investigation in any way that would cause the baseline mission to be compromised in the event that the SC component is not funded; encounters technical, schedule, or cost problems; or fails in flight. A SC must be dependent upon the proposed mission being implemented, *e.g.*, require the provision of flight elements and/or access to science/engineering data generated by the mission. SC elements that involve only analysis of archival data may not be proposed. A SC may, but is not required to, have the potential to add value to the results of the mission. A SC must include appropriate plans for the mentoring and oversight of students to maximize the opportunity for teaching, learning, and success in contributing to the mission.

Although any proposed SC is an E/PO element, a SC may not be used as a component of the core E/PO program. If a proposed investigation is selected, NASA retains the option to fund or not to fund any proposed SC.

There is no minimum and no maximum allowable cost for a SC. NASA is providing a student collaboration incentive that is defined to be 1% of the PI-Managed Mission Cost Cap. Contributions to the SC are permitted. The proposed NASA cost of the SC, up to the student collaboration incentive, may be outside of the PI-Managed Mission Cost. If the SC costs NASA more than the student collaboration incentive, then the rest of the NASA cost of the SC must be within the PI-Managed Mission Cost.

A proposed SC will be evaluated only for its impact on mission feasibility. The merit of the proposed SC will be evaluated later, as part of the reviews leading to KDP-B; see *Explanatory Guide to the NASA Science Mission Directorate Educational Merit Evaluation Factors for Student Collaboration Elements*, or other Mission Directorate-specific documents in the applicable PEA-specific Program Library.

Requirement 71. If a proposal contains a SC, the proposal shall demonstrate that the proposed SC is clearly separable from the proposed Baseline and Threshold Investigations, to the extent that the SC will not impact the investigation in the event that the SC is not funded; that the SC fails during flight operations; or that the SC encounters technical, schedule, or cost problems during development (see Appendix B, Section I.3, for additional details).

Requirement 72. If a proposal contains a SC, the proposal shall identify the funding set aside for the SC; this funding may be outside the PI-Managed Mission Cost up to the student collaboration incentive or as specified in the applicable PEA, and any SC costs beyond the student collaboration incentive shall be within the PI-Managed Mission Cost.

5.8 Contributions

Contributions from sources other than those provided in the PEA, U.S. or non-U.S., are welcome. These may include, but are not limited to, labor, services, instruments, spacecraft(s), and/or alternative access to space (*e.g.*, host spacecraft, launch vehicle, and/or launch services). Limits to the amount of contributions will be stated in the PEA. Such contributions will not be counted against the PI-Managed Mission Cost, but they must be included in the calculation and discussion of the Total Mission Cost (Section 4.3.2).

The applicable PEA may specify unallowable sources of contributions. PEAs sponsored by SMD do not permit contributions of funding from SMD programs other than the funding offered through the applicable PEA.

Values for all contributions of property and services must be established in accordance with applicable cost principles. The cost of contributed hardware must be estimated as either: (i) the cost associated with the development and production of the item, if this is the first time the item has been developed and if the mission represents the primary application for which the item was developed; or (ii) the cost associated with the reproduction and modification of the item (*i.e.*, any recurring and mission-unique costs), if this is not a first-time development. If an item is being developed primarily for an application other than the one in which it will be used in the proposed investigation, then it may be considered as falling into the second category (with the estimated cost calculated as that associated with the reproduction and modification alone). If Government Furnished Equipment (GFE) is being contributed, then permission must be obtained from the appropriate Agency or Program; the permission must be included in the Letter of Commitment.

The cost of contributed labor and services must be consistent with rates paid for similar work in the proposer's organization. The cost of contributions does not include funding spent before the start of the investigation (*i.e.*, before initiation of Phase B). The value of materials and supplies must be reasonable and must not exceed the fair market value of the property at the time of the contribution.

Requirement 73. If a proposal includes one or more contributions, the proposal shall identify all contributions, the organizations providing the contributions, and the organizations providing the funding for the contributions; the costs for the contributions shall be clearly identified within the Total Mission Cost.

Requirement 74. If a proposal includes one or more contributions, the total value of the contributions shall be established in accordance with the applicable and stated cost principles.

Letters of Commitment are required from each organization responsible for a contribution (for U.S. organizations, see Section 5.10.1.1 and Requirement 83; for non-U.S. contributing organizations, see Section 5.9.2 and Requirement 78). Institutional Letters of Commitment for contributed Co-Investigator support are not required. The requirement for personal statements of commitment from contributed Co-Investigators is given in Section 5.10.1.3 and Requirement 85.

A contributed item that is essential for the success of the proposed investigation and/or is in the critical path of mission development is a risk factor. Risks include the failure of funding or contributions to materialize when they are outside the control of the PI. Mitigation may include, but is not limited to, descoping the contributed items and/or holding reserves to develop the contribution directly. When no mitigation is possible, this should be explicitly acknowledged (see Appendix B, Section H, for additional details).

Requirement 75. If a proposal includes contributions that are essential to the success of the proposed investigation or in the critical path, the proposal shall include: (i) demonstrations of clear and simple technical and management interfaces in the proposed cooperative arrangements, (ii) explicit evidence that the proposed contributions are within the contributors' scientific and technical capabilities, and (iii) contingency plans for dealing with potential failures of proposed cooperative arrangements or, where no mitigation is possible, an explicit acknowledgement to that effect.

Where a resource is being contributed (*e.g.*, launch services, host spacecraft), all of the information required might not be available to the proposer (*e.g.*, Appendix B, Section F.2). Nevertheless, the proposal must provide sufficient information on the availability of that resource for NASA to assess whether the mission's resource requirements can be met and how the PI will assure the mission's success.

Requirement 76. If a proposal includes contributed access to space, it must provide sufficient information for NASA to assess whether the mission's resource requirements can be met and how the PI will assure the mission's success.

5.9 Non-U.S. Participation Requirements

5.9.1 Overview of Non-U.S. Participation

NASA solicits research proposals from both U.S. and non-U.S. sources (see NFS 1835.016-70).

NASA's policies for international cooperation in space research projects may be found in NPD 1360.2A, *Initiation and Development of International Cooperation in Space and Aeronautics Programs*. The characteristics of successful international cooperation include mutual benefits, clearly defined division of responsibilities, responsibilities for each participant within known capabilities, recognition of export control laws prohibiting the unwarranted transfer of technology abroad, and no-exchange-of-funds. Because space research projects generally involve major investments of resources, and because NASA is a Government agency,

NASA's counterparts will generally be non-U.S. Government agencies rather than non-U.S. universities or private organizations.

Owing to NASA's policy to conduct research with non-U.S. entities on a cooperative, no-exchange-of-funds basis, NASA does not normally fund non-U.S. research proposals or non-U.S. research efforts that are part of U.S. research proposals. Rather, cooperative research efforts are normally implemented via agreements between NASA and the appropriate non-U.S. entity. Non-U.S. proposers, whether as primary proposers or as participants in U.S. research efforts, must arrange for non-U.S. financing for their portion of the research and provide a Letter of Commitment from the funding entity.

The direct purchase of supplies and/or services, which do not constitute research, from non-U.S. sources by U.S. award recipients is permitted.

5.9.2 General Guidelines Applicable to Non-U.S. Proposals and to U.S. Proposals that include Non-U.S. Participation

All non-U.S. proposals will undergo the same evaluation and selection process as those originating in the U.S. All proposals, U.S. and non-U.S., must be typewritten in English and must comply with all submission requirements stated in this AO and in Appendix B of this AO.

Requirement 77. Unless otherwise noted, proposals from non-U.S. entities shall not include a cost plan unless the proposal involves collaboration with a U.S. institution, in which case a cost plan that covers only the participation of the U.S. entity shall be included.

Requirement 78. Proposals from non-U.S. entities and proposals from U.S. entities that include non-U.S. participation shall be formally endorsed, through Letters of Commitment, by the responsible funding agency in the country of origin. The required elements in a Letter of Commitment for a contribution are given in Section 5.10.1.1. In addition to these required elements, endorsements from foreign entities shall indicate that the proposal merits careful consideration by NASA and that, if the proposal is selected, sufficient funds will be made available to undertake the proposed activity. Officials who are authorized to commit the resources of the non-U.S. funding agencies must sign these Letters of Commitment.

Contributions from non-U.S. sources offer benefits but also represent complexity and risk to a project. The stability and reliability of proposed partners, and the appropriateness of any proposed contribution, will be assessed as a programmatic risk element in the proposal.

Requirement 79. Proposals from U.S. proposers shall include a discussion of mitigation plans, where possible, for the failure of funding or contributions to materialize when they are outside the control of the PI. When no mitigation is possible, this should be explicitly acknowledged.

Mitigation may include, but is not limited to, descoping the contributed items and/or holding reserves to develop the contribution directly. Note that reserves held for this purpose will be considered by NASA to be encumbered. When no mitigation is possible, this must be explicitly acknowledged. In addition to budget and technical risk, non-U.S. contributions introduce schedule risk for implementing agreements, as well as for obtaining any necessary licenses for

exchanges of goods and technical data. An adequate and realistic schedule must be allocated for having international agreements executed. NASA will not normally initiate development of any international agreements until after the final selection decision; for a two-step competition, this is after the conclusion of the Phase A concept study.

Any proposed non-U.S. participation must be described at the same level of detail as that of U.S. partners, including the provision of technical, schedule, and management data. Failure to document technical and schedule data, management approaches, or failure to document the commitment of team members or funding agencies may cause a proposal to be found unacceptable.

Requirement 80. Any proposed non-U.S. contribution essential to the success of the proposed investigation shall be described at the same level of detail as those of U.S. partners.

Requirement 81. Proposals with non-U.S. participation shall include a table listing: (i) non-U.S. participants (individuals, institutions), (ii) roles and responsibilities, (iii) funding organization, (iv) approximate value of contribution and method for estimating value, and (v) cross-reference to any Letters of Commitment in the proposal appendix. Proposals with non-U.S. participation must clearly describe the flow of design requirements (potentially export controlled information) and hardware between U.S. and non-U.S. participants. This description may take the form of an exploded diagram (see Appendix B, Section J.4, for additional details).

5.9.3 Agreements with Selected Non-U.S. Participants

Should a non-U.S. proposal or a U.S. proposal with non-U.S. participation be selected, NASA's Office of International and Interagency Relations will arrange with the non-U.S. sponsor for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsor will each bear the cost of discharging its respective responsibilities.

It is the policy of NASA to establish formal agreements with non-U.S. partners in cooperation on flight missions. Owing to the short duration of the concept study phase, it is not possible for NASA to conclude an international agreement prior to the due date for Concept Study Reports. Additionally, in some cases, interim agreements may be put in place until a more permanent arrangement is reached.

5.9.4 Export Control Guidelines Applicable to Non-U.S. Proposals and to U.S. Proposals that include Non-U.S. Participation

Requirement 82. Non-U.S. proposals and U.S. proposals that include non-U.S. participation shall describe plans for compliance with U.S. export laws and regulations, *e.g.*, 22 CFR Parts 120-130 and 15 CFR Parts 730-774, as applicable to the circumstances surrounding the particular non-U.S. participation (see Appendix B, Section J.5, for additional details).

5.10 Additional Proposal Requirements

5.10.1 Letters of Commitment

Letters of Commitment signed by an institutional official must be provided from (i) all organizations offering contributions of goods and/or services (both U.S. and non-U.S., but

excluding Co-I and collaborator services) on a no-exchange-of-funds basis, including all non-U.S. organizations providing hardware or software to the investigation (see Section 5.8) and (ii) all major organizational partners in the proposal regardless of source of funding. See Appendix B, Section J.2, for additional details.

5.10.1.1 Letters of Commitment for Contributions

The required elements in an institutional Letter of Commitment for a contribution are: (i) evidence that the institution and/or appropriate Government officials are aware and supportive of the proposed investigation; (ii) a precise description of what is being contributed by the partner and what assumptions are being made about NASA's role; (iii) a statement that the organization intends to provide the contribution or required funding for the investigation, if it is selected by NASA; (iv) the strongest possible statement of financial commitment from the responsible organization to assure NASA that all contributions will be provided as proposed, including whether the contribution and/or funding has been approved and/or what further decisions must be made before the funding is committed by the partner; and (v) a signature by an official authorized to commit the resources of the organization for participation in the investigation (if it is not clear from the signer's title that the signer has the necessary authority, then the signer's authority should be explicitly stated in the Letter).

Requirement 83. For all U.S. organizations offering contributions, proposals shall include appropriate Letters of Commitment from both the organization(s) providing any contributed property or service and from the organization(s) providing any required funding.

The requirement for Letters of Commitment from non-U.S. organizations offering contributions is given in Section 5.9.2 and Requirement 78.

5.10.1.2 Letters of Commitment for Major Partners

Major partners are the organizations, other than the proposing organization, responsible for providing research leadership, project management, system engineering, major hardware elements, science instruments, integration and test, mission operations, and other major products or services as defined by the proposer. All other participants are regarded as not major. Major partners are listed in Section (i) of the Table of Proposal Partners (see Appendix B, Section J.1, for additional details).

The required elements in an institutional Letter of Commitment for a major partner are: (i) a statement of commitment for the effort that is assigned to that participant in the proposal, (ii) a description of what is being provided, and (iii) a signature by an official authorized to commit the organization.

Requirement 84. Unless otherwise explicitly exempted elsewhere in PEA, proposals shall include a Letter of Commitment from each major partner in the proposal, regardless of source of funding. For major partners providing one or more contributions, only a single Letter of Commitment is required.

5.10.1.3 Personal and Institutional Letters of Commitment

No personal Letters of Commitment are required for Co-Investigators or other proposal team members in the proposal. A proposal team member is defined to be any individual identified on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) proposal cover page. Proposal team members indicate their commitment to the proposed investigation through NSPIRES (see Appendix B, Section A.3, for instructions).

Requirement 85. Every proposal team member shall indicate his/her commitment to the proposed investigation and specifically to the role, responsibilities, and participating organization proposed for him/her, through NSPIRES.

Institutional Letters of Commitment are required from institutions that are contributing the services of team members as described in Section 5.10.1.1.

5.10.2 *Export Controlled Material in Proposals*

Under U.S. law and regulations, spacecraft and their specifically designed, modified, or configured systems, components, and parts are generally considered "Defense Articles" on the United States Munitions List and are, therefore, subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130.

While inclusion of export controlled material in proposals is not prohibited, proposers are advised that the inclusion of such material in proposals may complicate NASA's ability to evaluate proposals, as NASA may employ the services of non-U.S. citizens, who are not lawful permanent residents of the U.S., to review proposals submitted in response to this AO. In order to enable proper evaluation of proposals, any export-controlled information subject to ITAR must be marked with a notice to that effect.

Requirement 86. If the proposal contains export controlled material, the following statement shall be prominently displayed in Section A of the proposal (following the Proposal Summary Information):

“The information (data) contained in [insert page numbers or other identification] of this proposal is (are) subject to U.S. export laws and regulations. It is furnished to the Government with the understanding that it will not be exported without the prior approval of the proposer under the terms of an applicable export license or technical assistance agreement.”

Note that it is the proposer's responsibility to determine whether any proposal information is subject to the provisions of ITAR. Information about U.S. export regulations is available at <http://www.pmdtc.state.gov/> and at <http://www.bis.doc.gov/>.

5.10.3 *Classified Proposal Appendix regarding Heritage*

In order to increase the capabilities of investigations proposed in response to this AO while minimizing the development and operations risks within the PI-Managed Mission Cost Cap, proposers may choose to leverage technology that was developed by other institutions and

agencies as well as technology developed by NASA and NASA-funded partners. It is recognized that some technology relevant to proposed missions may have classified heritage.

Proposals that propose the use of hardware with classified heritage may provide a classified proposal appendix to NASA to allow validation of classified heritage claims. The classified appendix regarding heritage may include Letters of Validation for classified heritage claims from technology development sponsors. The proposer is responsible for determining what information is classified and what information is unclassified; any classified information provided to NASA must be handled appropriately.

Requirement 87. Proposals submitted in response to this AO, as well as the proposed investigations and all proposed technologies, shall be unclassified. The proposal shall be complete including an unclassified appendix regarding heritage (see Appendix B, Section J.9, for further details).

When a proposer submits a classified appendix regarding heritage in addition to a complete proposal, the evaluation processes (Section 7.1.1) will be supplemented. At least one reviewer with appropriate clearance and relevant expertise will review the classified appendix regarding heritage; this reviewer may be a member of the review panel or this reviewer may be a specialist reviewer. All findings generated during the review of the classified appendix regarding heritage will be unclassified, and these findings will be provided to the technical/management/cost review panel as input for assessing the technical, management, and cost (TMC) feasibility of the proposed approach for mission implementation. No clarifications will be requested concerning findings from evaluation of the classified appendix regarding heritage.

The entire proposal including the unclassified appendix regarding heritage will be read and evaluated by the entire evaluation review panel. The evaluation review panel will not have access to the classified appendix regarding heritage. Proposers are strongly encouraged to provide as much information and detail as possible on their technology heritage in the unclassified appendix regarding heritage.

The use of a classified appendix regarding heritage is being permitted for this AO as a trial. NASA will endeavor to use the information in the classified appendix regarding heritage to better understand the proposed investigation. However, NASA cannot guarantee that this process will be fully successful in informing the review panel of the impact of a classified appendix regarding heritage which they have not read. This process may or may not be included in future AOs.

If the proposer wishes to send a classified appendix regarding heritage to NASA, it must be provided to NASA Headquarters separately from the proposal and no later than the due date for the proposal. A single copy of the classified appendix regarding heritage must be submitted along with a cover letter referencing the submitted proposal by name, PI, and proposing organization. The proposer is responsible for determining the appropriate level of classification for the classified appendix regarding heritage. The proposer is responsible for obtaining any “need to know” permission for at least one reviewer with appropriate clearance and relevant expertise to evaluate the classified appendix regarding heritage; that permission should be

discussed in the cover letter. The proposer assumes all responsibility for determining the appropriate security clearance and method of deliver to NASA Headquarters of the classified appendix regarding heritage. The classified appendix regarding heritage must be handled and delivered to NASA Headquarters in compliance with NPR 1600.2, *NASA Classified National Security Information (CNSI)*.

Requirement 88. Proposers that choose to submit a classified appendix regarding heritage shall submit the appendix and a cover letter to NASA Headquarters no later than the proposal due date. The proposer shall determine the appropriate security classification for the classified appendix, the proposer shall obtain any permission required for a reviewer to read the classified appendix, and the proposer shall ensure that all appropriate security requirements are followed in delivering the classified appendix to NASA Headquarters.

The requirements on content and format of the classified appendix regarding heritage are the same as those for the unclassified appendix regarding heritage included in the proposal (see Appendix B, Section J.9, for further details) with the exceptions that (a) Letters of Validation may be included in the classified appendix regarding heritage and (b) the classified appendix regarding heritage is expected to be a hardcopy document even if the rest of the proposal is submitted electronically.

The address for delivery of the package containing the classified appendix is: Mail Custodian, Suite 1M40, 300 E Street SW, Washington, DC 20546. The package containing the classified appendix should be sent to NASA Headquarters by whatever means is appropriate (courier, U.S. Registered Mail, etc.). The point-of-contact for the applicable PEA should be notified that a classified appendix has been submitted.

6. Proposal Submission Information

6.1 Preproposal Activities

6.1.1 Preproposal Conference

Each PEA will state whether a preproposal conference will or will not be held. If a preproposal conference is to be held, information including date, location, and logistics, will be made available approximately 2 to 4 weeks after the PEA release on the SALMON-2 Acquisition Homepage at the URL given in Section 6.1.4.

All interested parties may attend. All expenses and arrangements for attending this meeting are the responsibility of the attendees. Note that travel and associated costs of attendance are not allowable as direct costs under another Federal Government award (*e.g.*, a contract, grant, or cooperative agreement). Government employees may attend and be authorized travel and associated costs as a matter of official business.

The purpose of this conference will be to address questions about the proposal process for this AO. Questions should be sent to the NASA POC identified in the applicable PEA. NASA personnel will address all questions that have been received no later than five working days prior to the Conference. Questions submitted after this date may be addressed at the Conference as time permits and as appropriate answers can be generated. Anonymity of the authors of all

questions will be preserved. Presentations made at the preproposal conference, including answers to all questions addressed at the conference, will be posted on the SALMON-2 Acquisition Homepage two weeks after this event. Additional questions and answers subsequent to the conference will also appear in this location, if necessary. Questions may be submitted until 14 days before the proposal due date given in the applicable PEA. It is expected that all questions and answers will be posted on the SALMON-2 Acquisition Homepage.

6.1.2 Notice of Intent to Propose

To assist the planning of the proposal evaluation process, NASA strongly encourages all prospective proposers to submit a Notice of Intent (NOI) to propose, before the NOI submittal deadline specified in the applicable PEA. Material in a NOI is deemed confidential and will be used for NASA planning purposes only. Submission of a NOI is not required for the submission of a proposal to this solicitation. Those who submit NOIs will receive any updates or AO amendments that may occur, up to the time of the proposal submittal deadline.

An NOI is submitted electronically by entering the requested information at <http://nspires.nasaprs.com/>. Submission of NOIs and proposals requires registration on the NSPIRES website. Proposers who experience difficulty in using the NSPIRES site should contact the Help Desk for assistance by E-mail at nspires-help@nasaprs.com or by telephone at (202) 479-9376, Monday through Friday, 8:00 a.m. – 6:00 p.m. Eastern Time.

The following information (to the extent that it is known by the NOI due date) is requested for the NOI:

- (a) Name, address, telephone number, E-mail address, and institutional affiliation of the PI.
- (b) Full names and institutional affiliations of each known Co-I. If any Co-Is or other proposal team members are from non-U.S. institutions, the vehicle by which these people expect to be funded should be identified in the comments box on the NOI form.
- (c) Answers to PEA specific questions, such as Type of MO. Each NOI and proposal can only be submitted in response to a single PEA.
- (d) A brief statement (150 words or less) for each of the following:
 - (i) Science, exploration, or technology objectives of the proposed investigation;
 - (ii) General design or architecture of the investigation; and
 - (iii) identification of any new technologies that may be employed as part of the investigation.
- (e) The name of the Lead Representative from each organization (industrial, academic, not-for-profit, and/or Government) included in the proposing team as may be known by the NOI due date. Lead Representatives can be identified by selecting that role for an individual within the "Team Member" section of the NOI. Any Lead Representatives (*e.g.*, industrial leads, foreign partner leads) not yet registered in NSPIRES can be listed in the appropriate "Program Specific Data" question. Such individuals should ensure that they are registered in NSPIRES in time for proposal submission.

6.1.3 Teaming Interest

As a result of recent AOs similar to this one, commercial aerospace and technology organizations have requested a forum to inform potential proposers of their services and/or products. NASA is willing to offer this service with the understanding that the Agency does not endorse any information thus transmitted and does not accept responsibility for the capabilities or actions of these organizations. The organizations listed on the Teaming Interest page accessible from the SALMON-2 AO Acquisition Homepage (see address given in Section 6.1.4) have expressed an interest in teaming with other organizations on SALMON-2 AO proposals. This is not a comprehensive list of organizations that are capable of teaming but is simply a list of those organizations that have asked to be included. Proposers are not required to team with any organization on this list.

6.1.4 The SALMON-2 Acquisition Home Page

The SALMON-2 Acquisition Homepage, available at <http://soma.larc.nasa.gov/SALMON-2/>, will provide updates and information on any AO addenda during the SALMON-2 AO solicitation process. It will provide links to the PEA-specific Program Library, information about the preproposal conference, a list of potential proposers and teaming partners, and questions and answers regarding the AO.

Updates to the PEA and any amendments will be posted on the NSPIRES website. A link will be provided on the SALMON-2 Acquisition Homepage to the NSPIRES index page for the PEA.

6.1.5 Point of Contact for Further Information

Inquiries specific to a PEA should be addressed to the PEA-specific POC identified in each PEA. All inquiries of a general nature should be directed to the SALMON-2 AO POC as designated in this section. Inquiries are preferred in writing and may be sent by E-mail; the character string "SALMON-2 AO" (without quotes) should be included in the subject line of all transmissions.

General inquiries may be addressed to the SALMON-2 AO POC:

Dr. Jeffrey Newmark

Science Mission Directorate

NASA Headquarters

Washington, DC 20546-0001

Tel: **202-358-0684**

Email: jeffrey.newmark@nasa.gov [POC updated August 15, 2016]

Questions, concerns, or requests for information or clarification regarding this AO shall be directed only to formal points of contact designated here or in the applicable PEA. No communications concerning this AO may be made to any other NASA official.

6.2 Proposal Preparation and Submission

6.2.1 Structure of Proposals

General NASA guidance for proposals is given in Appendix A of this AO, which is considered binding unless specifically amended in this AO or the applicable PEA. A uniform proposal format is required from all proposers to aid in proposal evaluation. The required proposal format

and contents are summarized in Appendix B; the requirements in Appendix B may be modified by the applicable PEA. Failure to follow Appendix B or the applicable PEA may result in reduced ratings during the evaluation process or, in some cases, could lead to rejection of the proposal without review.

Requirement 89. Proposals shall conform to the uniform proposal format outlined in Appendix B.

6.2.2 Certifications

The authorizing institutional signature on the proposal certifies that the proposing institution has read and is in compliance with the three required certifications printed in full in Appendix H. Therefore, it is not necessary to separately submit these certifications with the proposal.

If the certifications need to be amended, they may be submitted as an additional proposal appendix.

6.2.3 Submission of Proposals

Requirement 90. Proposals shall be submitted no later than the proposal submittal deadline specified in the applicable PEA.

Requirement 91. A proposal shall be submitted electronically as a single PDF file, via NSPIRES, NASA's master proposal database system, at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only.

Requirement 92. The proposing organization shall provide the proposal summary information that is requested by the NSPIRES system and that is called the Electronic Cover Page. The Electronic Cover Page shall be completed and submitted online. NSPIRES will automatically attach the Electronic Cover Page to the uploaded proposal document before the proposal is distributed to evaluators.

Requirement 93. The abstract included in the proposal summary information shall not contain proprietary or confidential information that the submitters wish to protect from public disclosure (see Section 7.4.1).

In order to submit a proposal via NSPIRES, it is necessary that (i) the proposing organization be registered in NSPIRES, (ii) the proposer provides proposal summary information by completing an electronic cover page within NSPIRES, (iii) all proposal team members who are named on the proposal's electronic cover page be registered in NSPIRES, (iv) all proposal team members commit to the proposal through NSPIRES, and (v) the proposal is submitted by an Authorized Organizational Representative (AOR) (not the PI, unless the PI is also an AOR) through NSPIRES.

Potential proposers should access this site well in advance of the proposal due date to familiarize themselves with its structure and operations, and to enter the requested identifier information. Every individual identified on the proposal's Electronic Cover Page as a proposal team member must be registered in NSPIRES. Such individuals must register themselves; that is, no one may

register a second party, even the PI of a proposal in which that person is committed to participate. The proposal's Electronic Cover Page must be submitted electronically by one of the officials at the proposing organization who is authorized to make such a submission. Every organization that intends to submit a proposal to NASA in response to this AO must be registered in NSPIRES. The organization's Electronic Business Point-Of-Contact (EBPOC) in the Central Contractor Registry (CCR) must perform such registrations. This final requirement serves as the organization's "electronic signature" for the proposal.

Frequently Asked Questions (FAQs) on the use of NSPIRES can be accessed through the NSPIRES Proposal Online Help site at <http://nspires.nasaprs.com/external/help.do>.

Requirement 94. The proposing organization and all individuals named as proposal team members on the proposal cover page shall be registered in NSPIRES

NSPIRES will email the PI and the AOR within minutes of submission to confirm proposal receipt. Proposers who do not receive such notification should first check their junk mail folders and if there is no email they should then contact the Program Scientist identified in the applicable PEA.

Proposals received after the submittal deadline will be treated in accordance with Appendix A, Section VII.

7. Proposal Evaluation, Selection, and Implementation

7.1 Overview of the Proposal Evaluation and Selection Process

Proposals will be assessed against criteria given in Section 7.2 by panels of individuals who are peers of the proposers in the relevant scientific, exploration, and technology areas. Proposals will be categorized in accordance with NFS 1872.403-1. The NASA AO Steering Committee will review the results of the proposal evaluations and categorizations, will conduct an independent assessment of the evaluation and categorization processes, and will approve the selection recommendation. After this review, the final evaluation and categorization results, the proposed PI-Managed Mission Cost, and the selection recommendation will be presented to the appropriate Mission Directorate Associate Administrator(s) and Management Council(s). Unless stated otherwise in the applicable PEA, the appropriate Mission Directorate Associate Administrator(s) is (are) the Selection Official(s), who will make the selections. Sections 7.1, 7.2, and 7.3 provide additional details on these activities.

7.1.1 Evaluation Process

All proposals will be initially screened to determine their compliance to requirements and constraints of this AO. Additional compliance checks occur during the evaluation process. Proposals that do not comply may be declared noncompliant and returned to the proposer without further review. A submission compliance checklist is provided in Appendix F. This checklist provides proposers a list of the items that NASA will check for compliance before releasing a proposal for evaluation. This checklist is for the convenience of proposers; it is not required that these be submitted as part of a proposal.

Proposals for each type of MO listed in Section 5.1 solicited in the applicable PEA and deemed compliant will be evaluated against the criteria specified in Section 7.2 by panels of individuals who are peers of the proposers. More than one panel (*e.g.*, a science/exploration/technology panel and a technical/management/cost panel) will evaluate proposals; each panel will evaluate proposals against different criteria. Panel members will be instructed to evaluate every proposal independently without comparison to other proposals. These panels may be augmented through the solicitation of nonpanel (mail-in) reviews, which the panels have the option to accept in whole or in part, or to reject.

Proposers should be aware that, during the evaluation and selection process, NASA may request clarification of specific points in a proposal; if so, such a request from NASA and the proposer's response must be in writing. In particular, before finalizing the evaluation of the feasibility of the investigation implementation (see Section 7.2.4), NASA will request clarification on specific, potential major weaknesses in the feasibility of investigation implementation that have been identified in the proposal. NASA will request clarification in a uniform manner from all proposers. The ability of proposers to provide clarification to NASA is extremely limited, as NASA does not intend to enter into discussions with proposers. A typical limited response is to direct NASA's attention to pertinent parts of the proposal without providing further elaboration.

7.1.2 Categorization and Steering Process

An *ad hoc* categorization subcommittee of the NASA AO Steering Committee, composed wholly of Civil Servants and Intergovernmental Personnel Act appointees (some of whom may be from Government agencies other than NASA) and appointed by the Associate Administrator(s) for the appropriate Mission Directorate(s), will convene to consider the peer review results and, based on the evaluations, categorize the proposals in accordance with procedures required by NFS 1872.403-1(e). The categories are defined as follows:

Category I. Well conceived and scientifically and technically sound investigations pertinent to the goals of the program and the AO's objectives and offered by a competent investigator from an institution capable of supplying the necessary support to ensure that any essential flight hardware or other support can be delivered on time and data that can be properly reduced, analyzed, interpreted, and published in a reasonable time. Investigations in Category I are recommended for acceptance and normally will be displaced only by other Category I investigations.

Category II. Well-conceived and scientifically or technically sound investigations which are recommended for acceptance, but at a lower priority than Category I.

Category III. Scientifically or technically sound investigations, which require further development. Category III investigations may be funded for development and may be reconsidered at a later time for the same or other opportunities.

Category IV. Proposed investigations which are recommended for rejection for the particular opportunity under consideration, whatever the reason.

Category III investigations may be considered for development funding. Any Category III investigation selected for funding will be invited to submit a revised statement of work and a revised budget for a technology development program that addresses developmental shortcomings identified during evaluation of the proposal. NASA will review the revised statement of work.

The NASA AO Steering Committee will then review the results of the evaluations and categorizations and will approve the selection recommendation. The AO Steering Committee will conduct an independent assessment of the evaluation and categorization processes regarding their compliance to established policies and practices, as well as the completeness, self-consistency, and adequacy of all supporting materials.

7.1.3 Selection Process

After the review by the AO Steering Committee, the final evaluation results will be presented to the appropriate Mission Directorate Associate Administrator(s), who will make the final selection(s). The Selection Official(s) may consult with senior members of the mission directorate(s) and the Agency concerning the selections.

As part of the selection decision, a decision will be made as to whether or not any Category III proposals will receive funding for further development.

7.2 Evaluation Criteria

7.2.1 Overview of Evaluation Criteria

The evaluation criteria below will be used to evaluate and categorize proposals as described in Section 7.1. For a PMO or some Focused Opportunities, the proposed investigation will encompass only the proposed contribution to the mission, not the entire mission. The evaluation criteria (which are defined more fully in the sections below) are as follows:

- Intrinsic science, exploration, or technology merit of the proposed investigation;
- Experiment science, exploration, or technology implementation merit and the feasibility of the proposed investigation; and
- Technical, management, and cost (TMC) feasibility of the proposed investigation, including cost risk.

The proposal categorizations, discussed in Section 7.1.2, will be based on these criteria. Unless the PEA specifies otherwise, for categorization, intrinsic merit is weighted approximately 40%, experiment implementation merit and feasibility is weighted approximately 30%, and TMC feasibility, including cost risk, is weighted approximately 30%.

These criteria are defined more fully in the following sections. Evaluation findings for each evaluation criterion will be documented with narrative text in the form of specific major and minor strengths and weaknesses, as well as an adjectival summary score. The adjectival summary scores for the first two criteria (intrinsic merit and experiment implementation merit) will be reported as Excellent, Very Good, Good, Fair, or Poor, as defined in the table below.

Summary Evaluation	Basis for Summary Evaluation
<u>Excellent</u>	A comprehensive, thorough, and compelling proposal of exceptional merit that fully responds to the objectives of the AO as documented by numerous and/or significant strengths and having no major weaknesses.
<u>Very Good</u>	A fully competent proposal of very high merit that fully responds to the objectives of the AO, whose strengths fully outbalance any weaknesses.
<u>Good</u>	A competent proposal that represents a credible response to the AO, having neither significant strengths nor weakness and/or whose strengths and weaknesses essentially balance.
<u>Fair</u>	A proposal that provides a nominal response to the AO, but whose weaknesses outweigh any perceived strengths.
<u>Poor</u>	A seriously flawed proposal having one or more major weaknesses (<i>e.g.</i> , an inadequate or flawed plan of research or lack of focus on the objectives of the AO).

The third criterion, TMC feasibility of the proposed investigation, including cost risk, will be reported as Low Risk, Medium Risk, or High Risk, as defined in the table below.

Summary Evaluation	Basis for Summary Evaluation
<u>Low Risk</u>	There are no problems evident in the proposal that cannot be normally solved within the time and cost proposed. Problems are not of sufficient magnitude to doubt the Proposer's capability to accomplish the investigation well within the available resources.
<u>Medium Risk</u>	Problems have been identified, but are considered within the proposal team's capabilities to correct within available resources with good management and application of effective engineering resources. Mission design may be complex and resources tight.
<u>High Risk</u>	One or more problems are of sufficient magnitude and complexity as to be deemed unsolvable within the available resources.

7.2.2 Intrinsic Science, Exploration, or Technology Merit of the Proposed Investigation

The information provided in a proposal will be used to assess the intrinsic science, exploration, or technology merit of the proposed investigation. Scientific, exploration, or technology merit will be evaluated for the Baseline Investigation and the Threshold Investigation; Science-Exploration-Technology Enhancement Options beyond the Baseline Investigation will not contribute to the assessment of the intrinsic merit of the proposed investigation. The factors for intrinsic merit include the following:

- Factor A-1. Compelling nature and priority of the proposed investigation's science, exploration, or technology goals and objectives. This factor includes the clarity of the goals and objectives; how well the goals and objectives reflect program, Agency, and National priorities; the potential impact of the investigation on program, Agency, and National science, exploration, or technology objectives; and the potential for fundamental progress, as well as filling gaps in our knowledge relative to the current state of the art.
- Factor A-2. Programmatic value of the proposed investigation. This factor includes the unique value of the investigation to make science, exploration, or technology progress in the context of other ongoing and planned missions; the relationship to the other elements of NASA's programs; how well the investigation may synergistically support ongoing or planned missions by NASA and other agencies; and the necessity for a space mission to realize the goals and objectives.
- Factor A-3. Likelihood of science, exploration, or technology success. This factor includes how well the anticipated measurements support the goals and objectives; the adequacy of the anticipated data to complete the investigation and meet the goals and objectives; and the appropriateness of the mission requirements for guiding development and ensuring success.
- Factor A-4. Science, exploration, or technology value of the Threshold Investigation. This factor includes the intrinsic value of the Threshold Investigation using the standards in the first factor of this section and whether that value is sufficient to justify the proposed cost of the investigation.

Factors A-1 through A-3 are evaluated for the Baseline Investigation assuming it is implemented as proposed and achieves technical success. Factor A-4 is similarly evaluated for the Threshold Investigation.

This evaluation will result in narrative text, including specific major and minor strengths and weaknesses, as well as an appropriate adjectival rating for the intrinsic merit of the proposed investigation.

7.2.3 Experiment Science, Exploration, or Technology Implementation Merit and Feasibility of the Investigation

The information provided in a proposal will be used to assess the merit of the plan for completing the proposed investigation, including the experiment implementation merit, feasibility, resiliency, and probability of science, exploration, or technology success of the proposed investigation. The factors for experiment implementation merit and feasibility include the following:

- Factor B-1. Merit of the instruments and investigation design for addressing the science, exploration, or technology goals and objectives. This factor includes the degree to which the proposed investigation will address the goals and objectives; the appropriateness of the selected instruments and investigation design for addressing the goals and objectives; the degree to which the proposed instruments and investigation can provide the necessary data; and the sufficiency of the data gathered to complete the science, exploration, or technology investigation.

- Factor B-2. Probability of technical success. This factor includes the maturity and technical readiness of the instruments; the adequacy of the plan to develop the instruments within the proposed cost and schedule; the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks; the likelihood of success in developing any new technology that represents an untested advance in the state of the art; the ability of the development team - both institutions and individuals - to successfully implement those plans; and the likelihood of success for both the development and the operation of the instruments within the investigation design.
- Factor B-3. Merit of the data and/or sample analysis plan. This factor includes the merit of plans for data and/or sample analysis, data archiving, and/or sample curation to meet the goals and objectives; to result in the publication of discoveries in the professional literature; and to preserve data and samples of value to the research and development community. Considerations in this factor include assessment of planning and budget adequacy and evidence of plans for well-documented, high-level data products and software usable to the entire research and development community; assessment of adequate resources for physical interpretation of data; an assessment of the planning and budget adequacy and evidence of plans for the preliminary evaluation and curation of any returned samples; reporting science, exploration, or technology results in the professional literature (*e.g.*, refereed journals); and assessment of the proposed plan for the timely release of the data to the public domain for enlarging its impact.
- Factor B-4. Science, exploration, or technology resiliency. This factor includes both developmental and operational resiliency. Developmental resiliency includes the approach to descoping the Baseline Investigation to the Threshold Investigation in the event that development problems force reductions in scope. Operational resiliency includes the ability to withstand adverse circumstances, the capability to degrade gracefully, and the potential to recover from anomalies in flight.
- Factor B-5. Probability of investigation team success. This factor will be evaluated by assessing the experience, expertise, and organizational structure of the investigation team and the experiment design in light of any proposed instruments. The role of each Co-Investigator will be evaluated for necessary contributions to the proposed investigation; the inclusion of Co-Is who do not have a well defined and appropriate role may be cause for downgrading of the proposal.
- Factor B-6. Merit of any Science-Exploration-Technology Enhancement Options (SEOs), if proposed. This factor includes assessing the appropriateness of activities selected to enlarge the impact of the investigation; the potential of the selected activities to enlarge the impact of the investigation; and the appropriate costing of the selected activities. The peer review panel will inform NASA whether the evaluation of the proposed SEO(s) impacted the overall rating for experiment implementation merit and feasibility. Lack of an SEO will have no impact on the proposal's overall rating for experiment implementation merit and feasibility.

Student Collaboration proposals, if any, will be evaluated only for the impact they have on experiment implementation feasibility to the extent that they are not separable; student collaboration proposals will not be penalized for any inherent higher cost, schedule, or technical risk, as long as the student collaboration is shown to be clearly separable from the

implementation of the Baseline Investigation. The intrinsic merit of student collaborations will not be evaluated at this time (see Section 5.7.2).

This evaluation will result in narrative text, including specific major and minor strengths and weaknesses, as well as an appropriate adjectival rating for the experiment implementation merit and feasibility of the proposed investigation.

7.2.4 TMC Feasibility of the Investigation Implementation, including Cost Risk

The technical and management approaches of all submitted investigations will be evaluated to assess the likelihood that they can be successfully implemented as proposed, including an assessment of the likelihood of their completion within the proposed cost and schedule. The factors for feasibility of investigation implementation include the following, as applicable for the investigation being proposed:

- Factor C-1. Adequacy and robustness of the instrument implementation plan. The maturity and technical readiness of the instrument complement will be assessed, as will the ability of the instruments to meet investigation requirements. This factor includes an assessment of the instrument design, accommodation, interface, heritage, and technology readiness. This factor includes an assessment of the instrument hardware and software designs, heritage, and margins. This factor includes an assessment of the proposer's understanding of the processes, products, and activities required to accomplish development and integration of the instrument complement. This factor also includes adequacy of the plans for instrument systems engineering and for dealing with environmental concerns. This factor includes an assessment of plans for the development and use of new instrument technology and the adequacy of backup plans to ensure success within the proposed cost and schedule when technologies having a TRL less than 6 are proposed.
- Factor C-2. Adequacy and robustness of the investigation design and plan for operations. This factor includes an assessment of the overall investigation design and investigation architecture, the spacecraft design and design margins (including margins for launch mass, delta-V, and propellant), the concept for operations (including communication, navigation/tracking/trajectory analysis, and ground systems and facilities), and the plans for launch services. This factor includes investigation resiliency – the flexibility to recover from problems during both development and operations – including the technical resource reserves and margins, system and subsystem redundancy, and reductions and other changes that can be implemented without impact to the Baseline Investigation. This factor will be applied only to the extent that it is appropriate for the proposals solicited by the applicable PEA.
- Factor C-3. Adequacy and robustness of the flight systems. This factor includes an assessment of the flight hardware and software designs, heritage, and margins. This factor includes an assessment of the proposer's understanding of the processes, products, and activities required to accomplish development and integration of all elements (flight systems, ground and data systems, etc.). This factor includes an assessment of the adequacy of the plans for spacecraft systems engineering, qualification, verification, mission assurance, launch operations, and entry/descent/landing. This factor includes the plans for the development and use of new technology and the adequacy of backup plans

to ensure success of the investigation when technologies having a TRL less than 6 are proposed. The maturity and technical readiness of the spacecraft, subsystems, and operations systems will be assessed. The adequacy of the plan to mature systems within the proposed cost and schedule, the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks, and the likelihood of success in developing any new technologies will be assessed. This factor will be applied only to the extent that it is appropriate for the proposals solicited by the applicable PEA.

- Factor C-4. Adequacy and robustness of the management approach and schedule, including the capability of the management team. This factor includes: the adequacy of the proposed organizational structure and WBS; the management approach including project level systems engineering; the roles, qualifications, and experience of the PI, PM, other named key management team members, and implementing organization, investigation management team, and known partners; the commitment, spaceflight experience, and relevant performance of the PI, PM, other named key management team members, and implementing organization, investigation management team, and known partners against the needs of the investigation; the commitments of partners and contributors; and the team's understanding of the scope of work covering all elements of the investigation, including contributions. Also evaluated under this factor is the adequacy of the proposed risk management approach, including any risk mitigation plans for new technologies, any long-lead items, and the adequacy and availability of any required manufacturing, test, or other facilities. The approach to any proposed descoping of investigation capabilities will be assessed against the proposed Baseline Investigation. The plans for managing the risk of contributed critical goods and services will be assessed, including the plans for any international participation, the commitment of partners and contributors, as documented in Letters of Commitment, and the adequacy of contingency plans for coping with the failure of a proposed cooperative arrangement or contribution. This factor also includes assessment of proposal elements such as the relationship of the work to the project schedule, the project element interdependencies, the associated schedule margins, and an assessment of the likelihood of launching by the proposed launch date. Also evaluated under this factor are the proposed project and schedule management tools to be used on the project.
- Factor C-5. Adequacy and robustness of the cost plan, including cost feasibility and cost risk. This factor includes proposal elements such as cost, cost risk, cost realism, and cost completeness including assessment of the basis of estimate, the adequacy of the approach, the methods and rationale used to develop the estimated cost, the discussion of cost risks, the allocation of cost reserves by phase, and the team's understanding of the scope of work (covering all elements of the investigation, including contributions). Proposals will be evaluated for the adequacy of the cost reserves and whether proposals with inadequate cost reserves demonstrate a thorough understanding of the cost risks. This factor also includes an assessment of the proposed cost relative to estimates generated using parametric models and analogies. Also evaluated under this factor are the proposed cost management tools to be used on the project.

Student Collaboration proposals, if any, will be evaluated only for the impact they have on TMC feasibility to the extent that they are not separable; student collaboration proposals will not be penalized for any inherent higher cost, schedule, or technical risk, as long as the student

collaboration is shown to be clearly separable from the implementation of the Baseline Investigation. The intrinsic merit of student collaborations will not be evaluated at this time (see Section 5.7.2).

This evaluation will result in narrative text, including specific major and minor strengths and weaknesses, as well as an appropriate risk rating for the TMC feasibility of the proposed investigation implementation.

7.3 Selection Factors

As described in Section 7.1.3, the results of the proposal evaluations based on the criteria above and the categorizations will be considered in the selection process.

Considering the critical role of the PI, PM, and their institutions, prior experience (especially in meeting cost and schedule constraints) will be an important risk factor in the selection of an investigation under this AO.

The Selection Official(s) may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among top-rated proposals, including, but not limited to, planning and policy considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the mission directorate(s). While NASA develops and evaluates its program strategy in close consultation with the NASA community through a wide variety of advisory groups, the NASA program is an evolving activity that ultimately depends upon the most current Administration policies and budgets, as well as program objectives and priorities that can change quickly based on, among other things, new discoveries from ongoing missions.

The overriding consideration for the final selection of proposals submitted in response to this AO will be to maximize science, exploration, or technology return and minimize implementation risk while advancing NASA's science, exploration, or technology goals and objectives within the available budget for this program. Therefore, the proposed PI-Managed Mission Cost will be considered in the final selection of investigations through this AO. Depending on the availability of proposals of appropriate merit, this objective may be achieved by the selection of investigation(s) at the PI-Managed Mission Cost cap for the applicable PEA, one or more investigations significantly below the PI-Managed Mission Cost cap that would allow a more rapid release of the next PEA, or a combination of investigations of various costs. Proposers are encouraged to propose well below the PI-Managed Mission Cost cap, as that permits greater flexibility and robustness in the program and in NASA.

7.4 Implementation of Selected Proposals

7.4.1 Notification of Selection

Following selection, the PIs of the selected investigations will be notified by telephone, followed by formal written notification which may include any special conditions or terms of the offer of selection (*e.g.*, partial selections, see Section II of Appendix A) and any special instructions for formulation. The formal notification will also include instructions for scheduling a debriefing at

which any issues noted during the evaluation that may require attention during formulation will be discussed, as well as instructions for initiating the project.

The Selection Statement for this solicitation, which is signed by the Selection Official(s), may include information from the proposal summary (abstract) for any proposal, whether or not it is selected. Since the Selection Statement is a releasable document, the proposal summary (abstract) shall not contain proprietary or confidential information that the submitters wish to protect from public disclosure

7.4.2 Award Administration and Funding

Oversight management responsibilities are assigned to the Program Office at the Center designated in the applicable PEA. The responsibilities of the Program Office will include oversight of investigation implementation; coordination of Government-furnished services, equipment, and facilities; and contract management for selected investigations.

It is anticipated that the Program Office will provide funding to each selected investigation.

For investigations selected under this AO that do not deliver flight hardware or software (*e.g.*, New Missions using Existing Spacecraft), it is anticipated that grants or cooperative agreements will be awarded.

For investigations selected under this AO that deliver flight hardware or software (*e.g.*, Partner Missions of Opportunity, Small Complete Missions, and Focused Missions of Opportunity), it is anticipated that contracts will be awarded to begin formulation, to be initiated as soon as possible after notification of selection. NASA Centers will receive funding via intra-agency funding mechanisms. Statements of Work (SOWs), cost and pricing data, and small business subcontracting plans will be required in order to put awards in place.

Should a non-U.S. proposal or a U.S. proposal with non-U.S. participation be selected, NASA's Office of International and Interagency Relations will arrange with the non-U.S. sponsoring agency for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency memorandum of understanding.

Proposals are not required to include SOWs and cost and pricing data for formulation and subsequent phases. These will be required only for investigations that are selected at the outcome of the competition. If more than one contractual arrangement between NASA and the proposing team is required, a separate SOW is required for each organization.

For those investigations that are selected, it will be in the best interest of their PI-led investigation management teams to provide SOWs and cost and pricing data in as timely a manner as possible. The process of awarding contracts cannot begin until SOWs and cost and

pricing data have been received, and funds cannot be provided to the implementing organizations until this process has been completed.

SOWs will be required for selected investigations regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the requirements for Phase A, as well as general task statements for Phases B through F. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government responsibilities (as applicable). SOWs need not be more than a few pages in length.

For contracts that exceed \$650K, the contractor will be required to provide cost and pricing data to support the cost estimate, in the format specified in NPR 5800.1, *Grant and Cooperative Agreement Handbook*, Section A, Exhibit A, and to certify the costs proposed for the contract in accordance with FAR 15.406-2.

7.4.3 Confirmation of Investigations

Per NPR 7120.5D NID, at the end of Phase B, NASA will conduct an independent review of the investigation's readiness to proceed. This review must be completed before the project will be authorized to spend more than 25% of the proposed PI-Managed Mission Cost. The results of the independent review and the project status will be presented to the Mission Directorate Program Management Council (PMC) at the Confirmation Review (KDP-C) for Confirmation to enter Phase C. If the project is classified Category 1 according to NPR 7120.5D NID, the Confirmation results will need subsequent approval from the Agency PMC. Following Confirmation, no rephasing between fiscal years of Phase E costs to Phase C/D will be permitted.

If an investigation selected and awarded under this SALMON-2 AO does not pass its Confirmation Review, or if additional sources of funding become available, NASA reserves the right to select for award another highly rated proposal that was previously submitted to this AO but not initially selected for funding.

7.5 Opportunity for Debriefing of Nonselected Proposers

Proposers of investigations that are not selected will be notified in writing and offered oral debriefings for themselves and a representative from each of their main partners (if any). Written debriefing materials will be provided at the time of the oral debriefing. Such debriefings may be in person at NASA Headquarters or by telephone if the proposal PI prefers. In the former case, please note that all expenses and arrangements for attending a debriefing are the responsibility of the attendee. Travel and associated costs of attendance are not allowable as a direct cost under another Federal Government award, *i.e.*, contract, grant, or cooperative agreement. Government employees may attend and be authorized travel and associated costs as a matter of official business.

7.6 Process for Appeals

7.6.1 Agency Procurement Ombudsman

The Agency Procurement Ombudsman, designated in NPD 5101.32, *Procurement*, will take action to resolve concerns, disagreements, and recommendations submitted by interested parties

that cannot be resolved at the Center level, or those having Agencywide implications, refer Center-specific issues to the appropriate Center Procurement Ombudsman for action, and periodically communicate with Center Procurement Ombudsmen on common Agencywide issues and refer those issues to the appropriate office for action. Under NPD 5101.32, the designated Agency Procurement Ombudsman is:

Director of the Contract Management Division
Office of Procurement
NASA Headquarters
Washington, DC 20546
USA

7.6.2 Protests

Only prospective offerors seeking contract awards under this AO have the right to file a protest, either at the Government Accountability Office (GAO) or with the Agency, as defined in FAR 33.101. The provisions at FAR 52.233-2 (“Service of Protest”) and NFS 1852.233-70 (“Protests to NASA”) are incorporated into this AO. Under both of these provisions, the designated official for receipt of protests to the Agency and copies of protests filed with the GAO is:

Assistant Administrator for Procurement
Office of Procurement
NASA Headquarters
Washington, DC 20546
USA

8. Conclusion

This SALMON-2 AO offers the NASA community an avenue to participate with NASA in accomplishing national science, exploration, and technology goals, while generating opportunities to enhance education and engage the public in the excitement of space discoveries. NASA invites both the U.S. and non-U.S. communities to participate in proposals for investigations to be carried out as a result of this Announcement.

/signed/

John M. Grunsfeld
Associate Administrator
for Science Mission Directorate

/signed/

William H. Gerstenmaier
Associate Administrator
for Human Exploration and Operations Mission Directorate

/signed/

Michael J. Gazarik
Director of Programs
Office of the Chief Technologist

APPENDIX A

GENERAL INSTRUCTIONS AND PROVISIONS *See NASA FAR Supplement, Part 1872.705-1*

I. INSTRUMENTATION AND/OR GROUND EQUIPMENT

By submitting a proposal, the investigator and institution agree that NASA has the option to accept all or part of the offeror's plan to provide the instrumentation or ground support equipment required for the investigation, or NASA may furnish or obtain such instrumentation or equipment from any other source as determined by the selecting official. In addition, NASA reserves the right to require use of Government instrumentation or property that subsequently becomes available, with or without modification, that meets the investigative objectives.

II. TENTATIVE SELECTIONS, PHASED DEVELOPMENT, PARTIAL SELECTIONS, AND PARTICIPATION WITH OTHERS

By submitting a proposal, the investigator and the organization agree that NASA has the option to make a tentative selection pending a successful feasibility or definition effort. NASA has the option to contract in phases for a proposed experiment and to discontinue the investigative effort at the completion of any phase. NASA may desire to select only a portion of the proposed investigation and/or that the individual participates with other investigators in a joint investigation. In this case, the investigator will be given the opportunity to accept or decline such partial acceptance or participation with other investigators prior to a NASA selection. Where participation with other investigators as a team is agreed to, one of the team members will normally be designated as its leader or contact point. NASA reserves the right not to make an award or cancel this AO at any time.

III. SELECTION WITHOUT DISCUSSION

The Government intends to evaluate proposals and award contracts without discussions with offerors. Therefore, each initial offer should contain the offeror's best terms from a cost or price and technical standpoint. However, the Government reserves the right to conduct discussions, if later determined by the Contracting Officer to be necessary.

IV. NONDOMESTIC PROPOSALS

The guidelines for proposals originating outside of the United States are the same as those for proposals originating within the United States, except that the additional conditions described in AO Section 5.9 shall also apply.

V. TREATMENT OF PROPOSAL DATA

It is NASA policy to use information contained in proposals and quotations for evaluation purposes only. While this policy does not require that the proposal or quotation bear a restrictive notice, offerors or quoters should, in order to maximize protection of trade secrets or other

information that is commercial or financial and confidential or privileged, place the following notice on the title page of the proposal or quotation and specify the information, subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals and quotations will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

RESTRICTION ON USE AND DISCLOSURE OF PROPOSAL AND QUOTATION INFORMATION (DATA)

The information (data) contained in (insert page numbers or other identification) of this proposal or quotation constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed for other than evaluation purposes; provided, however, that in the event a contract is awarded on the basis of this proposal or quotation, the Government shall have the right to use and disclose this information (data) to the extent provided in the contract. This restriction does not limit the Government's right to use or disclose this information (data), if obtained from another source without restriction.

VI. STATUS OF COST PROPOSALS

Submission of cost or pricing data, as defined in FAR 15.401, is required if the proposal exceeds \$650,000. The investigator's institution agrees that the cost proposal submitted in response to the Announcement is for proposal evaluation and selection purposes, and that, following selection and during negotiations leading to a definitive contract, the institution may be required to resubmit or execute all certifications and representations required by law and regulation.

VII. LATE PROPOSALS

The Government reserves the right to consider proposals or modifications thereof received after the date indicated for such purpose, if the selecting official deems it to offer NASA a significant technical advantage or cost reduction (see NFS 1815.208).

VIII. SOURCE OF SPACE INVESTIGATIONS

Investigators are advised that candidate investigations for space missions can come from many sources. These sources include those selected through this AO, those generated by NASA in-house research and development, and those derived from contracts and other agreements between NASA and external entities.

IX. DISCLOSURE OF PROPOSALS OUTSIDE THE GOVERNMENT

NASA may find it necessary to obtain proposal evaluation assistance outside the Government. Where NASA determines it is necessary to disclose a proposal outside the Government for evaluation purposes, arrangements will be made with the evaluator for appropriate handling of

the proposal information. Therefore, by submitting a proposal, the investigator and institution agree that NASA may have the proposal evaluated outside the Government. If the investigator or institution desires to preclude NASA from using an outside evaluation, the investigator or institution should so indicate on the cover. However, notice is given that if NASA is precluded from using outside evaluation, it may be unable to consider the proposal.

X. EQUAL OPPORTUNITY

For any NASA contract resulting from this solicitation, the clause at FAR 52.222-26, "Equal Opportunity," shall apply.

XI. PATENT RIGHTS

- a. For any NASA contract resulting from this solicitation awarded to other than a small business firm or nonprofit organization, the clause at NFS 1852.227-70, New Technology, shall apply. Such contractors may, in advance of a contract, request waiver of rights as set forth in the provision at NFS 1852.227-71, Requests for Waiver of Rights to Inventions.
- b. For any NASA contract resulting from this solicitation awarded to a small business firm or nonprofit organization, the clause at FAR 52.227-11, Patent Rights -- Retention by the Contractor (Short Form), (as modified by NFS 1852.227-11) shall apply.

XII. RIGHTS IN DATA

Any contract resulting from this solicitation will contain the Rights in Data – General clause: FAR 52.227-14.

XIII. SMALL AND SMALL DISADVANTAGED BUSINESS SUBCONTRACTING

- a. Offerors are advised that NASA is subject to statutory goals to allocate a fair portion of its contract dollars to SDB concerns, HBCUs, and OMIs, as these entities are defined in 52.219-8 and 52.226-2 of the FAR. Offerors are encouraged to assist NASA in achieving these goals by using best efforts to involve these entities as subcontractors to the fullest extent consistent with efficient performance of their investigations.
- b. Offerors are advised that, by law, NASA prime contracts resulting from this solicitation which offer subcontracting possibilities, exceed \$650,000, and are with organizations other than small business concerns, the clause at FAR 52.219-9 shall apply. Accordingly, offerors awarded contracts that exceed \$650,000, other than small business concerns, are required to submit small business subcontracting plans consistent with the FAR. Failure to do so will make the offeror ineligible for award. These subcontracting plans will be evaluated on the participation goals and quality and level of work performed by small business concerns overall, as well as that performed by the various categories of small business concerns listed in FAR 52.219-9, except for SDBs. Offerors shall separately identify and will be evaluated on participation targets of SDBs in North American

Industry Classification System (NAICS) codes determined by the Department of Commerce to be underrepresented industry sectors.

XIV. WITHDRAWAL OF PROPOSALS

Proposals may be withdrawn by the proposer at any time before award. Proposers are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances that dictate termination of evaluation.

APPENDIX B

REQUIREMENTS FOR PROPOSAL PREPARATION

INTRODUCTION

The following requirements apply to preparation of proposals in response to a Program Element Appendix (PEA) of the Second Stand Alone Mission of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO). While the body of the AO and the applicable PEA specify the general policies and requirements for preparing proposals, as well as for implementing investigations proposed in response to this opportunity, Appendix B contains the specific requirements for the format and content of the proposals. In the event of apparent conflicts between this Appendix and the policies and requirements specified within the body of the SALMON-2 AO and a PEA, the order of precedence is: the PEA, then the SALMON-2 AO, then Appendix B.

GENERAL REQUIREMENTS FOR FORMAT AND CONTENT

The following expands requirements in the AO, in particular Requirement 89 through Requirement 92.

Requirement B-1. Each proposal shall consist of one digital file in searchable, bookmarked PDF format, divided into readily identifiable and bookmarked sections that correspond and conform to Sections A through J of this appendix. The proposal digital file size as submitted is limited to 25 MB. It shall be typewritten in English and shall employ metric (SI) and/or standard astronomical units, as applicable. It shall contain all data and other information that will be necessary for scientific and technical evaluations; provision by reference to external sources, such as Internet websites, of additional material that is required for evaluation of the proposal is prohibited.

Requirement B-2. All parts of a proposal, including photographs and/or colored graphics, shall be printable on paper. Page size shall be either American standard 8.5 x 11 inches or European standard A4. Foldout pages (11 x 17 inches or A3) may also be employed at the proposers' discretion (see below for assessment of foldout pages against the page limit).

Requirement B-3. Text shall not exceed 55 lines per page. Margins at the top, both sides, and bottom of each page shall be no less than 1 inch if printed on 8.5 x 11 inch paper; no less than 2.5 cm at the top and both sides, and 4 cm at the bottom if printed on A4 paper. Single-column or double-column formats are acceptable for text pages. Type fonts for text and figure captions shall be no smaller than 12-point (*i.e.*, no more than 15 characters per inch; six characters per centimeter). There is no minimum requirement for fonts used within figures and tables but all text in figures and tables shall be legible; fonts smaller than 8-point are often illegible.

Proposal Structure and Page Limits		
Section	Contents	Page Limits
A	Graphic Cover Page Export Controlled Material statement Optional Restriction on Use statement	1 0.5 0.5
	PI Commitment	1
B	Fact Sheet	2
C	Table of Contents	None
D	Science, Exploration, or Technology Investigation	20
E	Experiment Implementation	
F	Investigation or Mission Implementation Schedule Foldout	15 (none on Schedule Foldout(s))
G	Management	
H	Cost and Cost Estimating Methodology Cost Table B3	8 (none on Table B3)
I	Acknowledgement of E/PO requirements Optional Student Collaboration plan	1 + 2 for optional student collaboration
J	Appendices (no others permitted):	
J.1	Table of Proposal Participants	None
J.2	Letters of Commitment	None
J.3	Resumes	None
J.4	Summary of Proposed Program Cooperative Contributions	None
J.5	Draft International Participation Plan Discussion on Compliance with U.S. Export Laws and Regulations	None
J.6	Compliance with Procurement Regulations by NASA PI Proposals	None
J.7	Discussion of End-of-Mission Spacecraft Disposal Requirements	None
J.8	Master Equipment List (MEL)	None
J.9	Heritage	None
J.10	List of Abbreviations and Acronyms	None
J.11	List of References (optional)	None

Requirement B-4. Proposals shall conform to the page limits specified in the *Proposal Structure and Page Limits* table. Every side of a page upon which printing appears will count against the page limits and, unless specifically exempted (*e.g.*, Requirement B-30, Requirement 44, and Requirement 53), each foldout page will count as two or more pages against the page limits as appropriate for its area (*e.g.*, a fold-out with the total area of two standard pages counts as two pages, *etc.*).

ELECTRONIC COVER PAGE SUBMISSION THROUGH NSPIRES

The following expands requirements in the AO, in particular Requirement 92.

Electronic submission must be through the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/>.

Requirement B-5. This AO requires that proposal summary information, referred to as the Electronic Cover Page, shall be submitted electronically. The forms for the Electronic Cover Page are found in NSPIRES at <http://nspires.nasaprs.com/>. The Electronic Cover Page shall be completed and submitted online accompanying the proposal. The electronic submission of the Electronic Cover Page alone does not satisfy the deadline for proposal submission.

The NSPIRES electronic cover page includes the response to the following instruction: “List all participants in this investigation, both requesting funding and not requesting funding, who do not appear on the proposal's cover page as a Co-Investigator, collaborator, or any other category of participant. Include name, institution, city, state or country, and a description of the role in five words or less (*e.g.*, data analyst, facility provider, support technician).” It is recognized that individuals may be affiliated with the proposed investigation without being listed as team members on the proposal cover page. The information provided is used to ensure that the evaluation panels do not include individuals who have participated in one or more proposals as reviewers as they have the appearance of being biased.

Requirement B-6. Proposers shall ensure that the response to this instruction includes all team members as may be known at this time not listed in the Team Member section of the cover page who participated in a substantial way in the development of the investigation concept or the proposal itself, or who will participate substantially in the development and conduct of the investigation.

PROPOSAL TEAM MEMBER COMMITMENT THROUGH NSPIRES

The following expands requirements in the AO, in particular Requirement 85 and Requirement 94.

Every proposal team member (*i.e.*, every individual identified on the NSPIRES proposal cover page) must indicate his/her commitment to the proposed investigation through NSPIRES prior to proposal cover page submission. Team members must additionally confirm the organization through which they are participating on this proposal; identification of the organization serves as the commitment to the team specified in Requirement 85.

A proposal team member will receive an E-mail from NSPIRES indicating that he/she has been added to the proposal by the PI. The proposal team member should log in to NSPIRES. Once logged in, the proposal team member should follow the link in the “Reminders and Notifications” section of his/her NSPIRES home page, titled “Need <role> confirmation for proposal <title> for Solicitation <<solicitation number>>.” On the “Team Member Participation

Confirmation” page, the proposal team member should read language about the Organizational Relationship, then click the “Continue” button.

If the contact information then displayed on the “Team Member Profile” screen is out of date, the proposal team member should update this information later using the “Account Mgmt” link in the NSPIRES navigation bar across the top. Prior to making that update, however, the team member should follow the on-screen prompts to identify the organization through which he/she is participating on this proposal. Click the “Link Relationship” button to the right side of the “Organizational Relationship” banner. Select the organization from the “Link Proposal to an Association” part of the page. If the correct organization is not displayed here, try using the “Add Association” button to add the organization to this list. Then click the “Save” button at the bottom of the page. If the team member cannot find the organization when searching in the “Add Association” area (*i.e.*, the organization is not registered), type in the formal name in the space provided (or select “Self” if appropriate). Once the organization is selected and the “Save” button is clicked, there is a confirmation page that allows the team member to edit that relationship if it was chosen incorrectly. Click “Continue.”

Note that the organization through which the proposal team member is participating in the proposal might not be the proposal team member’s primary employer or primary mailing address. If the address information is accurate (or once it has been edited to be accurate), the proposal team member may log out of NSPIRES.

NSPIRES will send an E-mail to both the team member and the PI confirming that the commitment was made and the organization was identified. The PI may additionally monitor the status of proposal team member commitments by examining the “Relationship Confirmed” column on the Team Member page of the NSPIRES proposal cover page record. Note that the proposal cover page cannot be submitted until all identified team members have confirmed their participating organization.

Requirement B-7. Every proposal team member named on the proposal cover page shall personally commit to the proposed investigation through NSPIRES and identify the organization through which he/she is participating. The PI and every proposal team member shall ensure that the organization listed on the proposal cover page is the organization through which the proposal team member is participating in the proposal.

A. FRONT MATERIAL

1. Graphic Cover Page

The following expands requirements in the AO, in particular Requirement 89.

Requirement B-8. A Graphic Cover Page shall preface every proposal. The Graphic Cover Page shall contain, at a minimum, the following information and elements displayed on the cover page of the proposal:

- The proposal title;
- The name of the proposing organization;

- The name of the PI;
- The name and title of an official who is authorized to commit the proposing organization through the submission of the proposal; and
- The signature of the PI and the authorizing official (unless these signatures appear on the Proposal Summary Information).

Optionally, the Graphic Cover Page may also contain:

- Any illustrations or graphic elements of the proposer's choice (or none); and
- Any additional information of the proposer's choice that is nonproprietary and that does not provide additional content beyond what is in the proposal (or none).

2. Export Controlled Material Statement

The following expands requirements in the AO, in particular Requirement 86.

Requirement B-9. If the proposal contains export controlled material, the statement in Section 5.10.2 shall be prominently displayed in Section A of the proposal.

3. Optional Restriction On Use Statement

Proposals may include the *Restriction on Use and Disclosure of Proposal and Quotation Information (Data)* statement found in Appendix A, Section V.

4. PI Commitment

The following expands requirements in the AO, in particular Requirement 22.

Requirement B-10. Every proposal shall include a commitment by the PI for the cost, schedule, and scientific, exploration, and technical performance of the investigation as described in Section 5.3.1.

B. FACT SHEET

The following expands requirements in the AO, in particular Requirement 89.

Requirement B-11. Every proposal shall include a fact sheet that provides a brief summary of the proposed investigation. Information conveyed on this fact sheet shall include:

- Science, exploration, or technology objectives (including the importance of the investigation objectives to the sponsoring program goals);
- Investigation overview;
- Instrument complement;
- Key instrument characteristics;
- Investigation management and participating organizations (including teaming arrangements, as known);
- Schedule summary;
- The proposed PI-Managed Mission Cost in real year dollars (RY\$) from Table B3; and

- The proposed Total Cost, including a breakdown of any contributed costs by contributing organization, in real year dollars (R Y\$) from Table B3.

C. TABLE OF CONTENTS

The following expands requirements in the AO, in particular Requirement 89.

Requirement B-12. Every proposal shall contain a table of contents that conforms to the outlines provided in Sections D through J of this appendix, below.

D. SCIENCE, EXPLORATION, OR TECHNOLOGY INVESTIGATION

The following expands requirements in the AO, in particular Requirement 11 through Requirement 18.

1. Investigation Background, Goals, and Objectives.

Requirement B-13. This section shall describe the goals and objectives of the investigation; the compelling nature of the investigation; and the investigation's value to advancing the mission goals and objectives.

2. Investigation Requirements and Baseline Investigation.

Requirement B-14. This section shall describe the investigation to be performed, the types of measurements to be taken; the characteristics, precision, and accuracy required to attain the scientific objectives; and the projected instrument performance. This section shall describe the data to be returned in the course of the investigation. The quality (*e.g.*, energy resolution, spatio-temporal resolution, elemental and charge state resolution, coverage, pointing accuracy, measurement precision, measurement limitations, geometric factor, etc.) and quantity (bits, images, etc.) of data that must be returned shall be described. The relationship between the proposed data products (*e.g.*, flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) and the scientific objectives, as well as the expected results, shall be described. How the science products and data obtained will be used to fulfill the scientific requirements shall be demonstrated and supported by quantitative analysis. These descriptions shall constitute the Baseline Science Investigation.

Requirement B-15. Traceability from investigation objectives to measurement requirements to instrument functional requirements and to top-level mission functional requirements shall be provided in tabular form and supported by narrative discussion. Projected instrument performance shall be compared to instrument functional requirements.

Table B1 of this appendix provides an example of a tabular Science Traceability Matrix, with examples of matrix elements. This matrix provides the reference points and tools needed to track overall investigation requirements, provide systems engineers with fundamental requirements needed to design the mission, show clearly the effects of any descoping or losses of elements, and facilitate identification of any resulting degradation to the science.

3. Threshold Investigation.

Requirement B-16. This section shall identify the minimum acceptable data and scientific return for the investigation (the Threshold Investigation), below which the investigation would not be worth pursuing. The Threshold Investigation is identified with the “Threshold Science Requirements” in NPR 7120.5D NID. The scientific, exploration, or technology value of the Threshold Investigation shall be discussed. NASA recognizes that, in some circumstances, the Threshold Investigation may be identical to the Baseline Investigation. In such cases, the proposer shall explain why there is no viable investigation below the Baseline Investigation.

E. EXPERIMENT IMPLEMENTATION

The following expands requirements in the AO, in particular Requirement 19 through Requirement 21 and Requirement 64 through Requirement 67.

1. Instrumentation.

Requirement B-17. This section shall describe the instrumentation and the rationale for its selection. It shall identify the individual instruments and instrument systems, including their characteristics and requirements, and indicate items that are proposed for development, as well as any existing instrumentation or design/flight heritage. It shall provide a clear understanding of how the concept will provide the required data, show how it can be accommodated by the spacecraft, demonstrate that instruments have the necessary unobstructed fields-of-view over the measurement period required, describe the technology readiness levels and the approach to bring systems to technology readiness level (TRL) 6 at KDP-C (Confirmation). If no development plan is needed, the reasons for this shall be explicitly stated and the rationale shall be described. A preliminary description of each instrument design, with a block diagram showing the instrument systems and their interfaces, along with a description of the estimated performance of the instrument, shall be included. These performance characteristics (which shall be considered as requirements on the flight system) shall include mass, power, volume, data rate(s), thermal, pointing (such as control, stability, jitter, drift, accuracy, etc.), spatial and spectral resolution, observable precision, retrieved parameter sensitivity and accuracy, and calibration requirements. This section shall demonstrate that the instrumentation can meet the measurement requirements, including factors such as retrieval results for each remote sensor, error analysis of the information in all sensors, vertical and horizontal resolution, signal-to-noise (S/N) calculations, etc. It shall also discuss effects, such as radiation and contamination, on each instrument’s measurement capabilities as a function of mission time.

Requirement B-18. The following information shall be provided for each science instrument proposed:

- Mass (include breakouts of electronics and optics);
- Viewing direction in body coordinates;
- Pointing accuracy and stability requirements
- Operational modes;
- Operational mode timeline;

- Data demand for each instrument operational mode;
- Onboard data processing and storage required from spacecraft;
- Power demand for each instrument operational mode including peak, average, and stand-by power; and
- Instrument thermal control capability.

2. Data Sufficiency.

Requirement B-19. This section shall discuss the quality and quantity of data to be generated by each instrument, as they relate to the proposed science investigation goals and objectives. The flow-down from science investigation goals to measurement objectives and instrument performance shall be stated clearly and supported by quantitative analysis.

3. Science Mission Profile.

Requirement B-20. This section shall discuss the science observing profile, including all mission-relevant parameters, such as orbit, navigation accuracy, operational time lines (including observing periods, data transmission periods and techniques, and time-critical events), etc. The manner in which the proposed investigation objectives, selected instruments, and measurement requirements drive the mission and operations plan should be apparent from this discussion.

4. Data Plan.

Requirement B-21. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving shall be described. The science products (*e.g.*, flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the appropriate NASA data archive and the formats and standards to be used. It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community. Proposals shall identify how they plan to satisfy the policies in Section 4.4 of the AO from the standpoint of hardware, software, personnel, and cost.

5. Science Team.

Requirement B-22. This section shall identify each key member (*i.e.*, one whose participation is essential to the success of the investigation development) of the science team and his/her role and responsibilities. Resumes or curriculum vitae of science team members shall be included as appendices to the proposal (see Section J.3 of this appendix). The role of each Co-I shall be explicitly defined, the necessity of that role shall be justified, and the funding source (NASA or contributed) for the PI and each Co-I shall be noted. Nonfunded members of the science team shall be identified in the proposal as collaborators (see Section 5.6.3 of the AO). The role of collaborators must be defined and justified.

6. Plan for Science-Exploration-Technology Enhancement Options (SEO)

If an SEO is proposed, this section shall define and describe the proposed activities (see Section 5.2.5 of the AO).

F. INVESTIGATION IMPLEMENTATION (Version A)

Version A: This version of Section F is applicable to all categories of SALMON investigations except for Small Complete Missions. For Small Complete Missions, see Version B of Section F.

The following expands requirements in the AO, in particular Requirement 23 through Requirement 50.

1. General Requirements.

Requirement B-23. Instrument Contingencies and Margins: This section shall summarize contingencies and margins of all instrument resources. For proposals for more than one instrument, the mass, telemetry, and power and reserves and margins must be identified separately for all the necessary components of each instrument in case only an individual instrument is selected from the proposed suite (see below for definitions of contingency and margin). Discuss the allocation of reserves and margin to the instrument and/or suite.

Requirement B-24. Performance and Design Margins: For the driving requirements derived from the Functional Requirements, this section shall provide estimates of implementation performance and design margins with respect to the required performance. At a minimum, it shall provide estimates of implementation performance and design margins with respect to the required performance for the following:

- Mass;
- Power;
- Data Storage;
- Any other driving requirements.

Definitions:

Contingency, when added to the current estimate for a resource, results in the maximum expected value for that resource. Percent contingency is the value of the contingency divided by the value of the resource, less the contingency.

Margin is the difference between the maximum possible capability of a resource (the physical limit or the agreed-to limit) and the maximum expected value for a resource. Percent margin for a resource is the available margin divided by its maximum expected value.

Example: A payload in the design phase has a maximum expected mass of 115 kg including a mass contingency of 15 kg. There is no other payload on the ELV and the ELV provider plans to allot the payload the full capability of the vehicle, if needed. The ELV capability is 200 kg. The mass contingency is $15/100 = 15\%$ and the mass margin is 85 kg or $85/115 = 74\%$.

Example: The end-of-life (EOL) capability of a spacecraft power system is 200 Watts, of which 75 Watts has been allocated to the instrument and 100 Watts has been allocated to the spacecraft bus. The power margin is the unallocated 25 Watts or $25/175 = 14.3\%$. The current best estimate for the instrument power is 60 Watts, leaving 15 Watts or $15/60 = 25\%$ contingency to the 75 Watt maximum expected value.

Acknowledging that the maximum expected resource value is equal to the maximum proposed resource value (including contingency), the above technical terms can be expressed in equation form as:

Contingency = Max Expected Resource Value – current estimate of Resource Value

$$\% \text{ Contingency} = \frac{\text{Contingency}}{\text{Max Expected Resource Value} - \text{Contingency}} \times 100$$

Margin = Max Possible Resource Value – Max Expected Resource Value

$$\% \text{ Margin} = \frac{\text{Margin}}{\text{Max Expected Resource Value}} \times 100$$

Requirement B-25. Science Operations: This section shall address, at a minimum, the following elements of science operations to the extent that they are applicable to the proposed investigation and that they are known at the time of proposal submission. Any additional elements that are applicable to explaining the science operations and demonstrating their feasibility shall also be addressed. This section shall provide, at a minimum, the following items:

- Description of ground systems and facilities, including supporting ground software required for development and testing;
- A discussion of the science operations plan, including nominal sequence planning and commanding, team training, availability of experts for operations, and science operations center development.

2. Development Approach.

Requirement B-26. This section shall describe the development approach. This description shall include, at a minimum, the following items:

- Systems engineering approach (*e.g.*, plans, tools, processes for requirements, interfaces, and configuration management);

- Mission assurance approach, including (i) fault tolerance and fault management, (ii) product assurance, and (iii) reliability (e.g., use or non-use of redundancy, requirements for burn-in of parts, requirements for total operating time without failure prior to flight, etc.);
- Identification of instrument to spacecraft interfaces;
- Design maturity and heritage of instrument elements by reference to Appendix 10, Heritage, of the proposal (see Section J of this appendix);
- Essential trade studies that are to be conducted;
- Approach to management and closure of action items, hardware discrepancies, test anomalies, etc.; and
- Approach for handling special processes.

3. New Technologies/Advanced Developments.

PEAs issued by OCT, including those that solicit a technology demonstration investigation as opposed to a science or exploration investigation, will require technologies to be matured to TRL-5, not TRL-6, no later than KDP-C (Confirmation). Requirement B-27 is not applicable to such PEAS and will be replaced by requirements in the applicable PEA.

Requirement B-27. This section shall describe any proposed new technologies and/or advanced developments and the approaches that will be taken to reduce their associated risks. If no advanced development is required, the justification for TRL 6 or above shall be clearly demonstrated. These descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed new development and/or advanced development at the time the proposal is submitted (for *TRL definitions*, see NPR 7120.8, *NASA Research and Technology Program and Project Management Requirements*, Appendix J);
- Rationale for combining the TRL values of components to derive the full subsystem as proposed;
- Rationale for combining the TRL values of subsystems to derive the full system TRL as proposed;
- Rationale for the stated TRL value of a system that is an adaptation of an existing component, subsystem, or system of known TRL;
- The proposed approach for maturing each of the identified items to a minimum of TRL 6, defined as “model or prototype demonstration in a relevant environment, space, or ground” by the end of Phase B (include discussion of simulations, prototyping, systems testing, life testing, etc., as appropriate);
- An estimate of the resources (manpower, cost, and schedule) required to complete the technology development; and
- Approaches to fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance liens they impose on the baseline design, and the decision milestones for their implementation.

4. Assembly, Integration, Test, and Verification.

Requirement B-28. An illustration and brief discussion of the time-phased flow of the Integration and Test (I&T) Plan shall be presented. It shall summarize the key facilities, testbeds, and team members involved in the I&T Plan.

Requirement B-29. The investigation's verification approach shall be described briefly in this section. Flow diagrams, narrative text, and/or other relevant data may be used to convey this information. Elements of the approach that pose special challenges for the project (*e.g.*, mission critical performance or functional requirements that can't be tested on the ground, special facilities that may be required for testing, large scale simulation tools that must be developed and how they will be validated, critical path items, etc.) shall be highlighted. The I&T description shall demonstrate the credibility of the overall I&T approach, as reflected by consistency between the described test plans and the schedule, cost, and other resources needed to carry them out.

5. Schedule.

Requirement B-30. A project schedule foldout(s) covering all phases of the investigation shall be provided. This foldout will not be counted against the page limits. The schedule format shall indicate the month and year of each milestone, have a corresponding table of dates, and follow standard NASA WBS elements for task descriptions, as prescribed in NPR 7120.5D NID. The schedule foldout and accompanying narrative shall address proposed major milestones including, at a minimum, the following items:

- Instrument development and major review dates, including instrument-to-spacecraft/host integration and test;
- Ground systems development and major review dates (*e.g.*, science operations and data analysis development schedule);
- Major deliverables (*e.g.*, interface control documents (ICDs), simulators, engineering modules, flight modules, *etc.*);
- Long-lead item specifications, development paths, and their impacts to schedule;
- Schedule critical path identification; and
- Funded schedule reserve, with indications of appropriate reserves associated with major milestones and deliverables.

F. INVESTIGATION IMPLEMENTATION (Version B)

Version B: This version of Section F is applicable to Small Complete Missions. Address the following requirements in Version B to the extent applicable for the Small Complete Mission being proposed. For other categories of SALMON investigations, see Version A of Section F.

The following expands requirements in the AO, in particular Requirement 4 and Requirement 23 through Requirement 50.

1. General Requirements and Mission Traceability.

Requirement B-31. This section shall provide a description of the spaceflight mission that is proposed to enable the science investigation.

In some areas (*e.g.*, instruments), the data requested may have already been presented in another section of the proposal (*e.g.*, the Experiment Implementation section). In such a case, a proposal may provide a reference to that section and need not repeat the data in this section.

Requirement B-32. The mission requirements that the science goals and objectives impose on the mission design elements, including mission design, instrument accommodation, spacecraft design, required launch vehicle capability, ground systems, communications approach, and mission operations plan, shall be provided in tabular form and supported by narrative discussion. Table B2 provides an example of a tabular Mission Traceability Matrix, with examples of matrix elements. Specific information that describes how the science investigation imposes unique requirements on these mission design elements shall be included.

This matrix, along with Table B1, provides the reference points and tools needed to track overall mission requirements, provides systems engineers with fundamental requirements needed to design the mission, shows clearly the effects of any descoping or losses of mission elements, and facilitates identification of any resulting degradation to the science.

Requirement B-33. NASA recognizes that the full depth of information requested in Requirement B-46 through Requirement B-44 may not be available for some aspects of mission implementation at this stage of mission design. In such cases, this section shall (i) describe the current design concept, (ii) explain why the design information is not complete, (iii) provide a time-based plan for completing the design, (iv) justify that the development of that aspect of the design is not required at this stage and that it is acceptable to develop details later, and (v) explain why the lack of information at this stage does not translate into a risk to the proposer's ability to implement the mission as proposed. The approach for developing the required depth of information, along with a corresponding development schedule, shall be included among the plans for future activity. In cases where a mission is proposed at or near the cost cap, but depth of technical implementation detail is deferred, the proposal shall justify the adequacy of the proposed cost reserves to prevent increases beyond the cost cap during formulation and implementation of the mission.

This requirement is levied to establish NASA's standard for completeness of information necessary to support a comprehensive assessment of implementation feasibility and risk. The quality of the proposal's response to this requirement contributes significantly to the quality of the Technical, Management and Cost (TMC) assessment. However, NASA recognizes the preliminary nature of Pre-Phase A proposals, and thus Requirement B-33 will apply to all cases where the required information cannot, for whatever reason, be provided.

2. Mission Concept Descriptions.

Requirement B-34. Designs for all elements of the mission shall be described in sufficient detail to demonstrate that the proposed concept meets all of the basic requirements for a space flight mission, including mission design, spacecraft design, and supporting ground systems. Discussion of how the various mission elements meet the Mission Functional Requirements shall be included. At a minimum, the following mission elements shall be addressed: mission design, flight system capabilities, mission operations, and any additional elements.

Requirement B-35. Mission Design: This section shall address the following elements of mission design to the extent that they are applicable to the proposed mission and that they are known at the time of proposal submission. Any additional elements that are applicable to explaining the mission and demonstrating its feasibility shall also be addressed.

- Launch readiness date (including launch date flexibility);
- Mission duration;
- Orbit type (Earth orbit, heliocentric, etc.) and orbit information (semimajor axis, eccentricity, inclination, node time of day, argument of perigee, altitude), and/or trajectory design, as applicable to the proposed investigation;
- Critical events; and
- Ground station(s) usage (*e.g.*, location(s), transmitting and receiving communication parameters).

Requirement B-36. Launch Services and Launch Vehicle Compatibility: Any non-NASA launch services shall be described. For both NASA- provided and non-NASA provided launch services, compatibility with the proposed launch vehicle shall be demonstrated by providing in the appropriate proposal section the launch site, fairing size, spacecraft mass, and mission orbit characteristics such as altitude (km – circular or apogee/perigee), inclination, etc. Describe any known nonstandard requirements such as additional fairing doors, cleanliness and purge requirements, etc.

Requirement B-37. Flight System Capabilities: This section shall address the following flight system capabilities to the extent that they are applicable to the proposed mission and that they are known at the time of proposal submission. Any additional elements that are applicable to explaining the mission and demonstrating its feasibility shall also be addressed.

- Spacecraft Parameters:
 - (a) Figure of the complete spacecraft/instrument system, on the launch vehicle and inflight, with major components labeled and approximate overall dimensions.
 - (b) Block diagram of the spacecraft subsystems and their components.
- Subsystem descriptions including structure, telecommunications, thermal, power, propulsion (if required), attitude determination and control, command and data handling, in-flight fault management, flight software, and ground software. (Note that the discussion of the telecommunications subsystem should be limited to specifications, design, and proposed component hardware – discussion of the link performance is addressed as part of the mission operations approach). Subsystem detail shall include to the extent possible the following information:

- (a) Propulsion, including (i) Delta-V budget; (ii) for each propulsion mode propulsion type(s) (monoprop, bi-prop, dual-mode, solar electric, etc.), engines and thrust levels, and specific impulse; (iii) propellant allocation (impulse vs. attitude control system); and (iv) propellant margin, including nominal (to meet Delta-V requirement) and additional (to meet mass growth).
- (b) Command and Data Handling, including (i) spacecraft housekeeping data rates for nominal and safing strategy; (ii) data storage unit size (Mbits); and (iii) maximum storage record and playback rate.
- (c) Power, including (i) expected power requirement for each mission phase; (ii) minimum power capability needed to meet all requirements; and (iii) associated battery Depth of Discharge (DOD).
- (d) Attitude Determination and Control, including system pointing requirements and capabilities. Describe or define the following: (i) each spacecraft operational mode, including the sensors and actuators used, control method, and safing and/or contingency modes; (ii) attitude determination methodology and estimate of accuracy, including identifying whether ground post-processing is required to meet science needs; (iii) agility requirements for slews or scanning; (iv) appendage pointing requirements, including articulation control methods and deployment accommodations; (v) sensor selection and performance, including identifying mounting location and field-of-view (FOV); (vi) actuator selection and sizing, including identifying mounting location(s); (vii) translational maneuver (Delta-V) control and accuracy; (viii) momentum management approach and mitigation of impacts on navigation accuracy, if applicable; (ix) on-orbit calibrations, if required, including expected accuracy; and (x) attitude control requirements for the spacecraft pointing control, pointing knowledge (at the instrument interface), pointing stability, or jitter. (e) Thermal control, including (i) temperature requirements, (ii) temperature control approach (i.e. passive vs. active), and (iii) special thermal design considerations (e.g., cryogenic instrument requirements).

Requirement B-38. Flight System Contingencies and Margins: This section shall summarize contingencies and margins of all key flight systems resources. For the driving mission element requirements derived from the Mission Functional Requirements, it should provide estimates of implementation performance and design margins with respect to the required performance. At a minimum, it shall include the following:

- Mass;
- Propellants;
- Power;
- Data Storage; and
- Attitude Control System.

For any other driving mission element requirements derived from the Mission Functional Requirements, provide estimates of implementation performance and design margins with respect to the required performance.

Contingency and *Margin* are defined following Requirement B-24.

Requirement B-39. Mission Operations: This section shall address, at a minimum, the following elements of mission operations to the extent that they are applicable to the proposed mission and

that they are known at the time of proposal submission. Any additional elements that are applicable to explaining the mission operations and demonstrating their feasibility shall also be addressed. This section shall provide, at a minimum, the following items:

- Description of ground systems and facilities, including supporting ground software required for development and testing;
- Telecommunications, Tracking, and Navigation (Deep-Space, Lunar, and Earth Orbital missions, as well as missions that utilize telecom relay orbiters), including (i) downlink information data volume; (ii) uplink information; (iii) for all transmit and receive modes, provide mode timeline, data rate(s), and durations; and (iv) ground network utilization plan, including ground stations, downlink parameters (frequencies, periods, capacities, margins, etc.), and retransmission capability;
- Description of approach for acquiring and returning critical event data, including clear identification of procurement and costing for supplemental resources (*e.g.*, mobile ground stations) if such are needed; and
- A high-level discussion of operations plan, including nominal sequence planning and commanding, team training, availability of spacecraft experts for operations, and operations center development.

3. Development Approach.

Requirement B-40. This section shall describe the development approach. This description shall include, at a minimum, the following items:

- Systems engineering approach (*e.g.*, plans, tools, processes for requirements, interfaces, and configuration management);
- Mission assurance approach, including (i) fault tolerance and fault management, (ii) product assurance, and (iii) reliability (*e.g.*, use or nonuse of redundancy, requirements for burn-in of parts, requirements for total operating time without failure prior to flight, etc.);
- Identification of instrument to spacecraft interfaces;
- Design maturity and heritage of mission elements (instruments, spacecraft, ground systems, and mission design, etc.) by reference to Appendix 10, Heritage, of the proposal (see Section J of this appendix);
- Essential trade studies that are to be conducted;
- Approach to management and closure of action items, hardware discrepancies, test anomalies, etc.; and
- Approach for handling special processes.

4. New Technologies/Advanced Developments.

PEAs issued by OCT, including those that solicit a technology demonstration investigation as opposed to a science or exploration investigation, will require technologies to be matured to TRL-5, not TRL-6, no later than KDP-C (Confirmation). Requirement B-41 is not applicable to such PEAS and will be replaced by requirements in the applicable PEA.

Requirement B-41. This section shall describe any proposed new technologies and/or advanced developments and the approaches that will be taken to reduce their associated risks. If no

advanced development is required, the justification for TRL 6 or above shall be clearly demonstrated. These descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed new development and/or Advanced development at the time the proposal is submitted (for *TRL definitions*, see NPR 7120.8, *NASA Research and Technology Program and Project Management Requirements*);
- Rationale for combining the TRL values of components to derive the full subsystem as proposed;
- Rationale for combining the TRL values of subsystems to derive the full system TRL as proposed;
- Rationale for the stated TRL value of a system that is an adaptation of an existing component, subsystem, or system of known TRL;
- The proposed approach for maturing each of the identified items to a minimum of TRL 6, defined as “model or prototype demonstration in a relevant environment” by KDP-C (include discussion of simulations, prototyping, systems testing, life testing, etc., as appropriate);
- An estimate of the resources (manpower, cost, and schedule) required to complete the technology development; and
- Approaches to fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance liens they impose on the baseline design, and the decision milestones for their Implementation.

5. Assembly, Integration, Test, and Verification.

Requirement B-42. An illustration and brief discussion of the time-phased flow of the Integration and Test (I&T) Plan shall be presented. It shall summarize the key facilities, testbeds, and team members involved in the I&T Plan.

Requirement B-43. The project's verification approach shall be described briefly in this section. Flow diagrams, narrative text, and/or other relevant data may be used to convey this information. Elements of the approach that pose special challenges for the project (*e.g.*, mission critical performance or functional requirements that can't be tested on the ground, special facilities that may be required for testing, large scale simulation tools that must be developed and how they will be validated, critical path items, etc.) shall be highlighted. The I&T description shall demonstrate the credibility of the overall I&T approach, as reflected by consistency between the described test plans and the schedule, cost, and other resources needed to carry them out.

6. Schedule.

Requirement B-44. A project schedule foldout(s) covering all phases of the investigation shall be provided. This foldout will not be counted against the page limits. The schedule format shall indicate the month and year of each milestone, have a corresponding table of dates, and follow standard NASA Work Breakdown Structure (WBS) elements for task descriptions as prescribed in NPR 7120.5D NID. The schedule foldout and accompanying narrative, which is included in the page count for this section, shall address proposed major milestones including, at a minimum, the following items:

- Spacecraft development and major review dates;

- Instrument development and major review dates, including instrument-to-spacecraft/host integration and test;
- Ground systems development and major review dates (*e.g.*, mission operations and data analysis development schedule);
- Major deliverables (*e.g.*, Interface Control Documents (ICDs), simulators, engineering modules, flight modules, etc.);
- Launch vehicle integration and launch readiness;
- Compliance with NEPA and Launch Approval processes, if appropriate;
- Long-lead item specifications, development paths, and their impacts to schedule;
- Schedule critical path identification; and
- Funded schedule reserve, with indications of appropriate reserves associated with major milestones and deliverables.

G. MANAGEMENT

The following expands requirements in the AO, in particular Requirement 27, Requirement 40 through Requirement 49, and Requirement 79.

Requirement B-45. This section shall describe the investigator's proposed management approach. The management organization (including an organization chart) and decision-making process shall be described, and the teaming arrangement and team communications shall be discussed. The organization chart should clearly indicate how the investigation team is structured. The names of the primary team members, their organization, and their reporting relationship in the program shall be provided.

Requirement B-46. This section shall describe the specific roles and responsibilities of the PI, PM, and other named key management team members. It shall describe the qualifications and experience, especially any previous experience with similar systems and/or equipment (including their performance in meeting cost and schedule), of these key management team members, and demonstrate that they are commensurate with the technical and managerial needs of the proposed investigation. It shall also describe the qualifications and experience of the primary implementing institutions and demonstrate that they are commensurate with the technical and managerial needs of the proposed investigation.

Requirement B-47. This section shall describe the top risks considered significant by the PI and the PM, especially technical risks and risks associated with contributed hardware (if any), and potential mitigation strategies and associated schedule impacts. If cost risks are in this list, they should be described here and then discussed per Section H of this appendix (see Requirement B-51). The management strategies for control, allocation, and release of technical margins, cost reserves, and schedule reserves shall be described. The approach to any potential descopes, including savings of resources (mass, power, dollars, schedule, etc.) by implementing descopes, and the decision milestone(s) for implementing descopes shall be discussed. Specifically, this description shall identify how these margins and reserves are to be allocated, tracked, and monitored, with what tools and by whom, and who will have the authority to release them. When contracts are required, the acquisition strategy, including any incentive strategy, shall be described.

Requirement B-48. If the proposal contains proposed contributions or cooperative arrangements, this section shall describe the technical and management interfaces in any proposed cooperative arrangements, explicitly demonstrating that the contributions are within the contributors' scientific and technical capabilities, and contingency plans for coping with potential failures of the proposed cooperative arrangements.

Requirement B-49. In the case where a proposal does not provide the required management and schedule details, for whatever reason, this section shall (i) describe the current management approach and schedule, (ii) justify that the development of that aspect of the project management and schedule is not required at this stage and that it is acceptable to develop details later, (iii) explain why the lack of information at this stage should not translate into a risk to the proposer's ability to implement the investigation as proposed, and (iv) justify the adequacy of the proposed cost reserves. The process for developing the required depth of information, along with a corresponding schedule, shall be explicitly included among the plans for future activity.

H. COST AND COST ESTIMATING METHODOLOGY

The following expands requirements in the AO, in particular Requirement 52 through Requirement 63 and Requirement 74.

This section of the proposal must include an estimated cost of the investigation, a description of the methodologies used to develop the estimate, and a discussion of cost risks.

Requirement B-50. This section shall include the estimated cost of the proposed investigation. The estimated cost shall encompass all proposed activities, including all applicable mission phases, flight systems, ground systems, contributions, any other AO-specific activities, and all cost reserves. These costs shall be consistent with the policies and requirements described in Section 4 and Section 5 of this AO.

Requirement B-51. This section shall include a description of the methodologies used to develop the estimate. The cost estimating methodology discussion in this section shall provide an overview of the cost estimate development process. Any additional cost estimates or other validation efforts shall be described, the results presented, and any significant discrepancies discussed. The rationale for the proposed cost reserve levels shall be presented. Proposers shall provide additional Basis of Estimate data to assist the validation of their cost estimates. Examples of useful Basis of Estimate data include cost comparisons to analogous items/missions, vendor quotes, and parametric model results.

Requirement B-52. This section shall include a discussion of cost risks.

Requirement B-53. This section shall provide a foldout cost table, Table B3, which will not be counted against the page limit. Table B3 shall identify the proposed cost required in each mission phase and in each fiscal year; the costs shall be in real year dollars (RY\$). The top portion of Table B3 shall contain cost data relevant to the PI-Managed Mission Cost. The lower portion shall contain cost data for contributions. The rows in Table B3 shall be the NASA standard WBS

elements, as defined in NPR 7120.5D NID. The WBS must provide adequate insight into each individual instrument. The columns in Table B3 shall be grouped and subtotaled by mission phase and shall be labeled with the appropriate fiscal years. Fiscal years that span more than one mission phase shall be split into two columns by mission phase. The final columns total is in real year dollars (RY\$). Proposers shall use their own approved forward pricing rates. For organizations that are without approved forward pricing rates, proposers may use the most recent NASA inflation/deflation indices available at <http://www.nasa.gov/offices/ipce/CA.html>. The NASA FY 2011 new start inflation index for use in FY 2012 is provided in Table B4.

Requirement B-54. This section shall include a statement as to whether the proposer's approved forward pricing rates were used or NASA's inflation/deflation indices were used. If the proposer's approved forward pricing rates were used, this section shall include an explanation for how the forward pricing rates were derived.

I. ACKNOWLEDGEMENT OF EDUCATION AND PUBLIC OUTREACH REQUIREMENTS AND OPTIONAL STUDENT COLLABORATION PLAN

The following expands requirements in the AO, in particular Requirement 68 through Requirement 72.

1. Education and Public Outreach

Requirement B-55. This section shall include the required statement of commitment from the PI (see Section 5.7.1 of this AO).

2. Student Collaboration

Requirement B-56. If a Student Collaboration (SC), as described in Section 5.7.2 of this AO, is proposed, then this section shall provide details of the development schedule of the SC, including decision points for determining SC readiness for flight. This section shall describe how the SC can be incorporated into the mission on a nonimpact basis. This section shall show that the SC is clearly separable from the rest of the proposed effort.

J. APPENDICES

The following expands requirements in the AO, in particular Requirement 89.

Requirement B-57. The following additional information is required to be supplied with the proposal as Appendices and, as such, will not be counted within the specified page limit, except as noted. No other appendices are permitted.

1. Table of Proposal Participants

The following expands requirements in the AO, in particular Requirement 81.

Requirement B-58. A table of proposal participants shall be provided. The table shall include all organizations named in the proposal including contributing organizations. The primary purpose of the table is to aid NASA in avoiding conflicts of interest during the evaluation of the proposal. A secondary purpose is to provide material helpful for the evaluation and selection process. The table shall have three columns: (i) name of organization, including city and state/country where it is located, (ii) role of organization, and (iii) total cost or budget for that organization (real year dollars over the life of the proposal for baseline investigation). The table shall have a row for every organization named in the proposal, and the rows shall be organized into three sections: (i) major partners; (ii) science only, nonhardware partners; and (iii) minor partners, vendors, and suppliers, as known at the time of the proposal. Major partners are defined to be organizations responsible for providing project management, system engineering, major hardware elements, science instruments, integration and test, science operations, and other major elements of the proposed investigation, as defined by the proposer.

2. Letters of Commitment.

The following expands requirements in the AO, in particular Requirement 78, Requirement 83, and Requirement 84.

Requirement B-59. Letters of commitment signed by an institutional official authorized to commit the resources of the respective institution or organization shall be provided from (i) all organizations offering contributions of goods and/or services on a no-exchange-of-funds basis, including all non-U.S. organizations providing hardware, or software, and, (ii) all major participants in the proposal regardless of source of funding. Major partners are the organizations in section (i) of the Table of Proposal Participants. Requirements for letters of commitment may be found in Section 5.10.1 of this AO.

3. Resumes.

The following expands requirements in the AO, in particular Requirement 40, Requirement 41, Requirement 65, and Requirement 67.

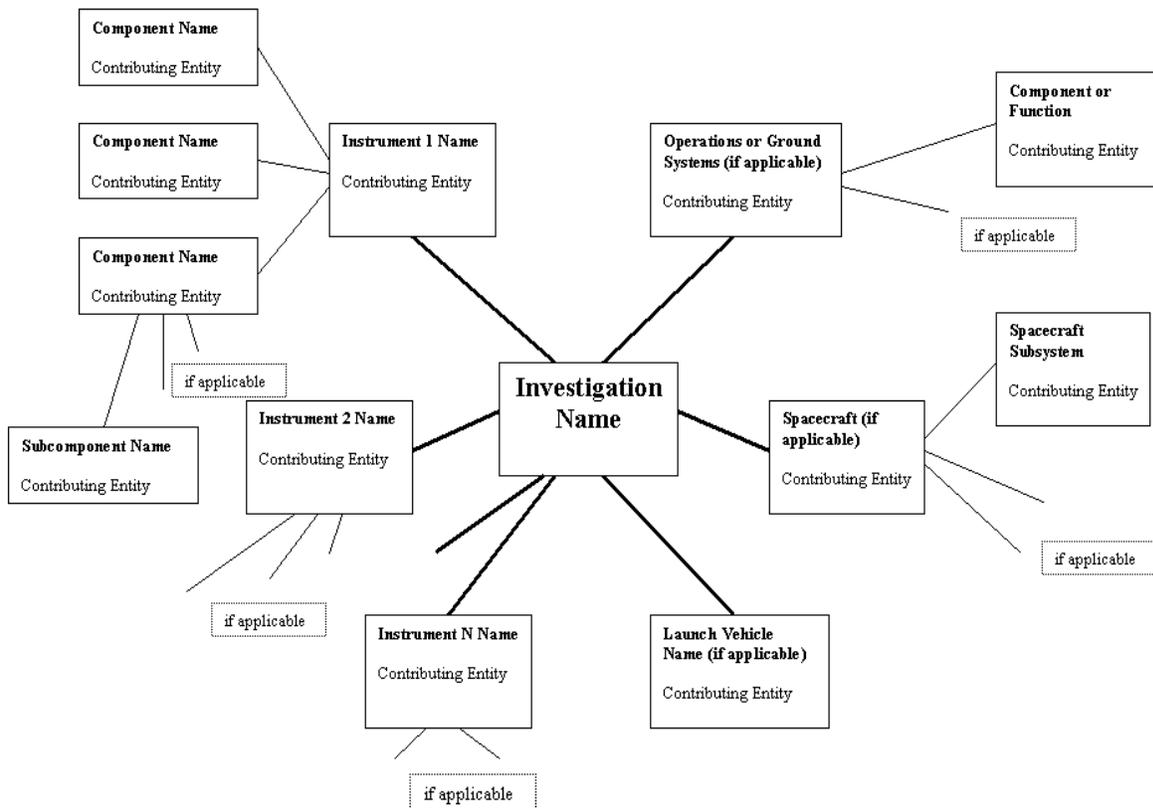
Requirement B-60. This section shall include resumes or curriculum vitae for the PI, PM, Project Scientist (PS), Project Systems Engineer (PSE), all Co-Is identified in the science section, and for any key project personnel who are named in the proposal. Specifically, each resume shall cite the individual's experience that is pertinent to the role and responsibilities that she/he will assume in the proposed investigation. Project management experience shall be included in the resumes of the PI, PM, PS (if named), and PSE. Resumes or curriculum vitae shall be no longer than three pages for the PI and one page for each additional participant. Resumes shall be organized alphabetically, by surname after that of the PI.

4. Summary of Proposed Program Cooperative Contributions.

The following expands requirements in the AO, in particular Requirement 73 through Requirement 75 and Requirement 81.

Cooperative contributions are defined to be those that are to be provided to the proposed investigation from a U.S. or non-U.S. partner on a no-exchange-of-funds basis. In order to aid NASA in conducting an equitable assessment of risks, this section shall include (a) an “exploded diagram” of the investigation and (b) a supporting table.

SAMPLE EXPLODED DIAGRAM



a. An “exploded diagram” of the investigation.

Requirement B-61. If a proposal includes cooperative contributions, this section shall include an “exploded diagram” of the investigation (see example figure) that provides a clear visual representation of cooperative contributions incorporated in the proposed implementation approach. All cooperative contributions, including those that will require an international agreement or interagency memorandum of agreement, shall be shown in this diagram. Each

contribution shown shall display a unique name for the contribution, as well as the identity of the contributing entity. However, the following should not be shown:

- i. If there are no cooperative contributions of spacecraft, launch vehicle or services, or ground operations or facilities, these boxes should not be shown on the diagram at all.
- ii. Scientific collaborations, such as joint data analysis that do not involve contribution of flight hardware or other critical items, should not be shown.
- iii. U.S. or non-U.S. goods and services obtained by contract using NASA funds are not cooperative contributions and are also not to be shown.

b. A supporting table of collaborative contributions.

Requirement B-62. If a proposal includes cooperative contributions, this section shall include a supporting table with more information that elaborates upon each cooperative contribution shown in the exploded diagram. The table shall include, for each contribution, the following information:

- i. Unique name identifying the contribution (matching the name on the exploded diagram);
- ii. The identity of the providing organization, whether U.S. or non-U.S.;
- iii. The roles and responsibilities of the providing organization, including cross reference to information in the proposal providing further detail as required in Section 5.8 of this AO;
- iv. The identification of the funding sponsor, if different from the organization identified in item (ii) above;
- v. The approximate value of the contribution, in U.S. dollars, as defined in Section 5.8 of this AO; and
- vi. Cross reference to letters of commitment, as required in Section 5.10.1 (and references therein) of this AO.

5. Draft International Participation Plan - Discussion on Compliance with U.S. Export Laws and Regulations.

The following expands requirements in the AO, in particular Requirement 82.

Requirement B-63. If a proposal includes international participation, either through involvement of non-U.S. nationals and/or involvement of non-U.S. entities, this section shall discuss compliance with U.S. export laws and regulations; *e.g.*, 22 CFR 120-130, *et seq.* and 15 CFR 730-774, *et seq.*, as applicable to the scenario surrounding the particular international participation. The discussion shall describe in detail the proposed international participation and is to include, but not be limited to, whether or not the international participation may require the proposer to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export license or whether a license exemption/exception may apply. If prior approvals via licenses are necessary, discuss whether the license has been applied for or, if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available at <http://www.pmdtc.state.gov/> and <http://www.bis.doc.gov/>. Proposers are advised that under U.S. law and regulation, spacecraft and their specifically designed, modified, or configured systems, components, parts, etc., such as instrumentation responsive to this AO, are generally

considered “Defense Articles” on the United States Munitions List and subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR 120-130, *et seq.*

Requirement B-64. Foreign nationals requiring access to NASA facilities and information systems will be required to comply with Homeland Security Presidential Directive (HSPD) 12 (see <http://www.dhs.gov/homeland-security-presidential-directive-12>) [**updated December 12, 2014**] and NASA Interim Directive (NID) NM 1600-95, *NASA Identity and Credential Management*, where applicable. This appendix shall also discuss the impact, if any, on the investigation and the proposed international participation of compliance with HSPD-12 and NM 1600-95. If no impact is anticipated, this shall be explicitly stated.

6. Compliance with Procurement Regulations by NASA PI Proposals.

The following expands requirements in the AO, in particular Requirement 51.

This appendix is required only for proposals submitted by NASA PIs or NASA Centers (excluding JPL). Proposals submitted by NASA Centers must comply with regulations governing proposals submitted by NASA PIs (NFS 1872.308). Additional instructions may be found in PIC 05-15 at <http://www.hq.nasa.gov/office/procurement/regs/pic.html>.

Requirement B-65. For NASA Center proposals, this section shall include any descriptions, justifications, representations, indications, statements, and/or explanations that are required by the regulations.

7. Discussion of End of Mission Spacecraft Disposal Requirements.

The following expands requirements in the AO, in particular Requirement 39.

This appendix is required only for proposed missions to Low Earth Orbit (LEO) (<2000 km perigee), near Geosynchronous orbit (GEO) ($GEO \pm 300$ km), or the Moon (orbiters and landers).

Requirement B-66. This section shall discuss briefly how the mission meets the orbit disposal requirement applicable to its proposed orbit. For LEO missions, this section shall briefly discuss the lifetime of the mission and whether it meets the 25-year post-mission (or 30-year from launch – whichever comes first) requirement for LEO missions.

Requirement B-67. This section shall include a mission lifetime analysis demonstrating satisfaction of the above requirement, addressing all assumptions and inputs contributing to the analysis. These assumptions and inputs shall include, at a minimum:

- Vehicle Mass
- Drag Area or Cross-sectional Area
- Initial orbit used for the analysis
- Solar and atmospheric conditions assumptions (*i.e.*, models or parameters)
- Methodology: analytical tool, table lookup, reference plot.

Requirement B-68. If the plan is to dispose of the satellite at the end of mission, this section shall provide the parameters of the disposal orbit, the delta-v allocation for disposal, and any other relevant assumptions.

The following references are available in NODIS and START (see Appendix D):

- NPR 8715.6A, *NASA Procedural Requirements for Limiting Orbital Debris*; and
- NASA-STD-8719.14, *NASA Process for Limiting Orbital Debris*.

8. Master Equipment List.

The following expands requirements in the AO, in particular Requirement 60.

Requirement B-69. This section shall include a Master Equipment List (MEL) summarizing all flight element subsystem components and individual instrument element components to support validation of proposed mass estimates, design heritage, and cost. A template for this MEL is included as Table B5.

For each component, current best estimates (CBE) and contingency for mass and power, number of flight units required, and some description of the heritage basis must be provided. Power values should represent nominal steady-state operational power requirements. Information to be provided includes identification of planned spares and prototypes, required deliveries for simulators and testing, contingency allocations for individual components, and other component description/characteristics. Certain items (like electronic boxes and solar arrays) should include additional details, as applicable, to identify and separate individual elements.

9. Heritage.

The following expands requirements in the AO, in particular Requirement 60, Requirement 87, and Requirement 88.

Requirement B-70. This section shall discuss each element of any heritage from which the proposed investigation derives substantial benefit, including heritage from spacecraft subsystems, instruments, ground systems, flight and ground software, test set ups, simulations, analyses, etc. This discussion shall be at an appropriate level of granularity (*e.g.*, component, assembly, subsystem) to clearly separate the heritage element from other elements of the design. The discussion of each element shall include:

- a concise description of the design heritage claimed;
- the anticipated benefits to the proposed investigation;
- a brief rationale supporting the claim that the benefits of heritage will be achieved; and
- for any proposed elements with substantial design heritage, a comparison of the cost of the heritage items to the proposed cost.

Proposals must substantiate all heritage claims, including descriptions of changes required to accommodate project-unique applications and needs. Where enhancements to heritage elements are proposed or heritage is from a different application, sufficient descriptions must be provided to independently assess the current level of maturity.

The evaluation team will use a scale with at least three levels (full, partial, or none) as illustrated in the table below.

	Full heritage	Partial heritage	No heritage
Design	Identical	Minimal modifications	Major modifications
Manufacture	Identical	Limited update of parts and processes necessary	Many updates of parts or processes necessary
Software	Identical	Identical functionality with limited update of software modules (<50%)	Major modifications (>=50%)
Provider	Identical provider and development team	Different however with substantial involvement of original team	Different and minimal or no involvement of original team
Use	Identical	Same interfaces and similar use within a novel overall context	Significantly different from original
Operating Environment	Identical	Within margins of original	Significantly different from original
Referenced Prior Use	In operation	Built and successfully ground tested	Not yet successfully ground tested

10. List of Abbreviations and Acronyms.

The following expands requirements in the AO, in particular Requirement 89.

Requirement B-71. This section shall provide a list of abbreviations and acronyms.

11. List of References (optional).

In addition to the above items, this section may provide a reference list of documents and other materials that were fundamentally important in generating the proposal. This may include a Uniform Resource Locator (URL) for documents that are available through the Internet. As noted at the outset of Appendix B of this AO, however, proposals must be self-contained: any data or other information intended as part of a proposal must be included within the proposal itself. If any documents or other materials are submitted as a part of a proposal, they must fit within the prescribed page limits. If internal documents such as Flight Project Practices are referenced, provide an accessible URL to download them.

TABLE B1
EXAMPLE SCIENCE TRACEABILITY MATRIX

Science Goals	Science Objectives	Scientific Measurement Requirements		Instrument Functional Requirements		Projected Performance	Mission Functional Requirements (Top Level)	
		Observables	Physical parameters					
Goal 1	Objective 1	Absorption line	Column density of absorber	Alt. Range	XX km	ZZ km	Observing strategies: requires yaw and elevation maneuvers	
Goal 2		Emission line	Density and temperature of emitter				Launch window: to meet nadir and limb overlap requirement. Window applies day to day	
Etc.		Objective 1	Morphological feature	Size of features	Vert. Resol.	XX km	ZZ km	Need AA seasons to trace evolution of phenomena
				Horiz. Resol.	XX deg x XX lat x XX long	ZZ deg x ZZ lat x ZZ long		
			Rate of change of observable phenomenon	Rise time of eruptive phenomenon	Temp. Resol.	XX min	ZZ min.	Need AA months of observation to observe variability of phenomena
				Precision	XX K	ZZ K		
				Accuracy	XX K	ZZ K		
Objective 2 to N					Repeat above categories			

TABLE B2
EXAMPLE MISSION TRACEABILITY MATRIX

Mission Functional Requirements	Mission Design Requirements	Spacecraft Requirements	Ground System Requirements	Operations Requirements
From Table B1	Rocket type Launch date: Mission length Orbit altitude requirement and rationale Geographic coverage and how it drives orbit requirement Orbit local time and rationale for the requirement Type of orbit, e.g. Sun synchronous, precessing, Lagrangian point, other Other	Spinning, stabilized Mass Power Volume: Data Rate Temperature Range for spacecraft systems Pointing Control: Knowledge, Stability, Jitter, Drift , Other Detector radiation shielding requirements and rationale Other	Passes per day and duration Assumed antenna size Data volume per day Real time data transmission requirements Transmit frequency Power available for comm (Watts) Downlink data rate Number of data dumps per day Spacecraft data destination (e.g., mission operations center) Science data destination (e.g., science operations center) Other	General spacecraft maneuver requirements and frequency Special maneuvers requirements Rationale for maneuvers Ephemeris requirements Changes in viewing modes and directions per orbit, per day or over longer time periods. Rationale for these changes Other
Msn Functional Req or Instrument Accommodation (from Table B1)	Mission	Spacecraft	Ground System	Operations
Four different observing strategies: Solar, limb, nadir, zenith; requires yaw and elevation maneuvers		Agility requirements Slew rate = y deg/sec Settle = stability < .001 deg/sec after 30 secs		Target planning on 3 day centers Ephemeris accuracy of x with updates every 2 days
Instrument X precision of 5K		Thermal stability of 1 deg/hr S/C bus stability of .01 deg over 10 secs	Bit error rate < $1e-5$ Time correlation to 2 msec over 1 week	Weekly time correlation

TABLE B3

TOTAL MISSION COST FUNDING PROFILE TEMPLATE

Cost by WBS elements should be provided to the extent that they are known
 An EXCEL version of this template is available in the PEA-specific Program Library.

WBS#	WBS Element	Phase A (FY2010-2011)		Phase B (FY2012-2013)		Phase C/D (FY 2014-2018)		Phase E (FY2018-2025)		Phase F FY2025	RYS Total
		FY2010	FY2011	Total	FY2012	FY2013	FY2014	Total	FY2018		
01	Project Management										
02	Systems Engineering										
03	Safety & Mission Assurance										
04	Science / Technology										
05	Payload(s) List each instrument separately										
5.1	Instrument 1										
5.1.1	Instrument 1 component A										
5.1.2	Instrument 1 component B										
5.1.n	Instrument 1 component n										
5.2	Instrument 2										
5.2.1	Instrument 2 component A										
5.2.2	Instrument 2 component B										
5.2.n	Instrument 2 component n										
5.x	Instrument X										
5.x.1	Instrument X component 1										
5.x.n	Instrument X component n										
07	Mission Operations										
09	Ground System(s)										
10	Systems Integration & Testing										
12	Reserves										
	PI-Managed Investigation Cost										
	Contributions										
	List by organization and WBS element										
	Total Contributions										
	Total Mission Cost										

TABLE B4
NASA FY 2011 NEW START INFLATION INDEX
for use in FY 2012

Fiscal Year	2012	2013	2014	2015	2016	2017	2018	2019
Inflation Rate		2.5%	2.6%	2.7%	2.7%	2.7%	2.5%	2.4%
Cumulative Inflation Index	1.000	1.025	1.052	1.080	1.109	1.139	1.168	1.196

Use an inflation rate of 2.5% for years beyond 2019.

Note: The latest version of this table is available at <http://www.nasa.gov/offices/ipce/CA.html>; the table is updated annually.

Note: Proposers shall use their own approved forward pricing rates. For organizations that are without approved forward pricing rates, proposers may use the most recent NASA new start inflation index available at <http://www.nasa.gov/offices/ipce/CA.html>. The NASA FY 2011 new start inflation index for use in FY 2012 is provided in Table B4 (see Appendix B, Section H).

APPENDIX C

GLOSSARY OF TERMS AND ABBREVIATIONS

Part C.1: GLOSSARY OF TERMS

Announcement of Opportunity (AO) — A document used to announce opportunities to participate in NASA programs.

AO Process — A term used to describe the program planning and acquisition procedure used to acquire investigations through an AO.

AO Steering Committee — A NASA committee composed wholly of full-time Federal Government employees that provides advice to the Mission Directorate Associate Administrator and provides procedural review over the investigation evaluation, categorization, and selection process.

Backward contamination — The transmittal to Earth from another body of viable organisms by a spacecraft or spacecraft component.

Baseline science investigation — The investigation that, if fully implemented, would accomplish the entire set of scientific objectives proposed for the investigation.

Baseline science objectives — The entire set of scientific objectives proposed for the investigation.

Basis of Estimate (BOE) — A record of the procedures, ground rules and assumptions, data, environment, and events that underlie a cost estimate's development or update. Good documentation of the BOE supports the cost estimate's credibility.

Categorization — The process whereby proposed investigations are classified into four categories synopsized here as Category I (recommended for acceptance); Category II (recommended for acceptance but at a lower priority than Category I proposals); Category III (sound investigations requiring further development); Category IV (not recommended).

Categorization Subcommittee — An *ad hoc* subcommittee of the AO Steering Committee, composed wholly of Civil Servants and Intergovernmental Personnel Act appointees (some of whom may be from Government agencies other than NASA) and appointed by the Associate Administrator for the Science Mission Directorate, that categorizes proposals for investigations submitted in response to an AO based on the evaluations.

Co-Investigator (Co-I) — An investigator who plays a necessary role in the proposed investigation and whose services are either funded by NASA or are contributed by his/her employer. A NASA employee can participate as a Co-I on an investigation proposed by a private organization.

Collaborator — An individual who is less critical to the successful development of the investigation than a Co-I. A collaborator may not be funded through the proposal. A collaborator may be committed to provide a focused contribution to the project for a specific task, such as data analysis. If funding support is requested in the proposal for an individual, that individual shall not be identified as a collaborator but shall be identified as a Co-Investigator or another category of team member.

Complete spaceflight mission — A science investigation requiring an Earth-orbiting, near-Earth, or deep-space mission, that encompasses all appropriate mission phases from project initiation (Phase A) through mission operations (Phase E) and spacecraft disposal (Phase F), including the analysis and publication of data in the peer reviewed scientific literature, delivery of the data to an appropriate NASA data archive, and, if applicable, extended mission operations or other science enhancements.

Contingency — That quantity, when added to a resource, results in the maximum expected value for that resource.

Contribution — Labor, services, or hardware funded by any source other than Program sponsoring the AO.

Desclope — Any alteration of an investigation that renders it unable to accomplish one or more of the Baseline Science Mission scientific objectives.

Earned Value Management (EVM) — A tool for measuring and assessing project performance through the integration of technical scope with schedule and cost objectives during the execution of the project. EVM provides quantification of technical progress, enabling management to gain insight into project status and project completion costs and schedules.

Federal Acquisition Regulation (FAR) — The regulations governing the conduct of acquisition.

Forward contamination — The transmittal from Earth to a targeted solar system body of viable organisms by a spacecraft or spacecraft component.

Guest Investigators — Investigators selected to conduct observations and obtain data within the capability of a NASA mission, which are additional to the mission's primary objectives. Sometimes referred to as Guest Observers or General Observers.

Implementing organization — The organization chosen by the Principal Investigator to manage the development of the investigation.

Investigation — Activities or effort aimed at the generation of new knowledge. NASA-sponsored investigations generally concern the generation and analysis of data obtained through measurement of space phenomena or Earth phenomena using spaceflight hardware developed and operated for that purpose.

Investigation Team — The group of scientists, engineers, and other professionals implementing an investigation.

Key Management Team Members — The project leaders whose qualifications and experience are relevant and necessary to the success of the project. Key management team members are the PI, PM, PSE, and, where appropriate, PS and partner leads, and other roles as identified in the proposal.

Margin — The allowance carried on a resource (*e.g.*, budget, schedule, mass) to account for uncertainties and risks. It is the difference between the maximum possible capability of a resource (the physical limit or the agreed-to limit) and the maximum expected value for a resource.

Mission — Used interchangeably with investigation.

Mission Architecture — The summary level description of the overall approach to the mission in the context of achieving the science objectives including mission elements such as flight systems, instruments, high-level mission plan, high-level operations concept, etc.

NASA FAR Supplement — Acquisition regulations promulgated by NASA in addition to the FAR.

Notice of Intent — A notice or letter submitted by a potential investigator indicating the intent to submit a proposal in response to an AO.

Payload — A specific complement of instruments, space equipment, and support hardware carried to space to accomplish a mission or discrete activity in space.

Peer Review (n) — A gathering of experts in related disciplinary areas convened as a subcommittee of the AO Steering Committee to review proposals for flight investigations.

Peer Review (v) — The process of proposal review utilizing a group of peers in accordance with the review criteria as outlined in the Announcement of Opportunity.

Performance Metrics — A multi-party agreement between the Program Office, the PI institution, the project management institution, and other major partners that is used for project evaluation by NASA.

PI-Managed Investigation Cost — The funding that the Program sponsoring the AO will be expected to provide to the PI's implementation team for the development and execution of the proposed project, mission Phases A through F. It includes any reserves applied to the development and operation of the investigation as well. It also includes any costs that are required to be accounted for against the PI-Managed Investigation Cost even though the PI is not responsible for those costs (*e.g.*, NASA-provided telecom and network).

Principal Investigator (PI) — The person who conceives of an investigation and leads implementation of it. The PI is invested by NASA with primary responsibility for implementing and executing selected investigations. A NASA employee can participate as a PI only on a Government-proposed investigation.

Program — An activity involving human resources, materials, funding, and scheduling necessary to achieve desired goals.

Project — Within a program, an undertaking with a scheduled beginning and ending, which normally involves the design, construction, and operation of one or more spacecraft and necessary ground support in order to accomplish a scientific or technical objective.

Project Office — An office established to manage a project.

Proposing Organization — The organization that submits the proposal; commonly this is also the Principal Investigator's home institution.

Reserve — Resource not allocated to any specific task but held by the project for unexpected needs.

Resiliency — The quality of an investigation to gracefully degrade from the Baseline Science Investigation to the Threshold Science Investigation as technical, schedule, or budgetary problems occur.

Risk — The combination of the probability that a program or project will experience an undesired event and the consequences, impact, or severity of the undesired event, were it to occur. The undesired event may come from technical or programmatic sources (*e.g.*, a cost overrun, schedule slippage, safety mishap, health problem, malicious activities, environmental impact, failure to achieve a needed scientific or technological objective, or success criterion). Both the probability and consequences may have associated uncertainties.

Selection Official — The NASA official designated to determine the source for award of a contract or grant.

Team — A group of investigators responsible for carrying out and reporting the results of an investigation or group of investigations.

Team Member — A participant in an investigation, including the Principal Investigator, a Co-Investigator, or any member of an investigation team. Team members are identified by role on the proposal's Electronic Cover Page.

Termination review — A review established to determine whether remedial actions, including changes in management structure and/or key personnel, would better enable a project to operate within established cost, schedule, and/or technical constraints. If a termination review determines that no remedy is likely to improve matters, NASA may consider termination of the project.

Threshold science investigation — The investigation that would accomplish the minimum subset of Baseline Science Mission scientific objectives sufficient to justify the proposed cost of the mission. The threshold science requirements set the science floor for the proposed mission.

Total Investigation Cost — The PI-Managed Investigation Cost, plus any additional costs that are contributed or provided in any way other than through the Program sponsoring the AO.

Unencumbered reserve — Reserves that are free of liens identified by proposers and are held for risks that may be realized during project execution.

Work Breakdown Structure (WBS) — A product-oriented hierarchical division of the hardware, software, services, and data required to produce a project's end product(s), structured according to the way the work will be performed, and reflective of the way in which program/project costs, schedule, technical and risk data are to be accumulated, summarized, and reported.

Part C.2: COST ELEMENT DEFINITIONS

This is a short dictionary of definitions for the cost elements shown in the tables and discussed in the body of this AO.

Education and Public Outreach — Includes all costs associated with developing and implementing the proposed investigation's programs for education and public outreach.

Instruments — Instrument costs include costs incurred to design, develop, and fabricate the individual scientific instruments or instrument systems through delivery of the instruments to the spacecraft for integration. Costs for instrument integration, assembly, and test are to be shown separately from instrument development.

Instrument Integration, Assembly, and Test (IAT) — Spacecraft integration, assembly and test is the process of integrating all instrument subsystems into a fully tested, operational instrument. The total cost of IAT for an instrument includes research/requirements specification, design and scheduling analysis of IAT procedures, ground support equipment, instrument test and evaluation, and test data analyses. Typical instrument tests include thermal vacuum, thermal cycle, electrical and mechanical functional, acoustic, vibration, electromagnetic compatibility/interference, and pyroshock.

Launch Approval Engineering or Launch Approval Process — The process by which National Environmental Protection Act and any applicable launch safety approval requirements are satisfied.

Launch Checkout and Orbital Operations — Launch checkout and orbital operations support costs are those involving prelaunch planning, launch site support, launch-vehicle integration (spacecraft portion), and the first 30 days of flight operations.

Launch Services — Launch vehicles and services are either procured and provided by NASA to launch spacecraft under fixed price contracts or provided by the proposer. The launch service price includes procurement of the ELV, spacecraft-to-launch vehicle integration, placement of spacecraft into designated orbit, analysis, postflight mission data evaluation, oversight of the launch service and coordination of mission-specific integration activities.

Mission Operations and Data Analysis (MO&DA) — This cost element refers only to Phase E (post-launch) and has two major components: Mission Operations and Data Analysis. Mission operations comprises all activities required to plan and execute the science objectives, including spacecraft and instrument navigation, control, pointing, health monitoring, and calibration. Data analysis activities include collecting, processing, distributing, and archiving the scientific data. MO&DA costs include postlaunch all costs for people, procedures, services, hardware, and software to carry out these activities. It includes post-launch science team support costs.

NASA Center Costs (all categories) — Additional costs borne by the science investigation for NASA Center participation. For example, there may be additional project management/systems engineering costs, above those incurred by the spacecraft prime contractor, which are due to NASA employee participation. These costs must be reported on a full-cost accounting basis.

Prelaunch Science Team Support — Includes all Phase A/ B/C/D (prelaunch) support costs for the science team. (See MO&DA below for postlaunch component.)

Prelaunch Ground Data System (GDS) /Mission Operations Services (MOS) Development — Includes costs associated with development and acquisition of the ground infrastructure used to transport and deliver the telemetry and other data to/from the Mission Operations Center and the Science Operations Center. (For more information, refer to *NASA's Mission Operations and Communications Services* document in the PEA-specific Program Library.) Includes development of science data processing and analysis capability. Also includes prelaunch training of the command team, development and execution of operations simulations, sequence development, and flight control software. This element includes any mission-unique tracking network development costs.

Project Management/Mission Analysis/Systems Engineering — Project management costs include all efforts associated with project level planning and directing of prime and subcontractor efforts and interactions, as well as project-level functions such as quality control and product assurance. Mission Analysis includes preflight trajectory analysis and ephemeris development. Systems engineering is the project-level engineering required to ensure that all satellite subsystems and payloads function properly to achieve system goals and requirements. This cost element also includes the data/report generation activities required to produce internal and deliverable documentation.

Project Manager (PM) — The individual responsible to the PI for overseeing the technical and programmatic implementation of the project. The PM works closely with the PI in order to ensure that the mission meets its objectives within the resources committed to the project.

Project-Unique Facilities — If the proposed science investigation requires construction or lease of any ground facilities, include here only the portion of costs to be borne by the proposed investigation, with description of the nature and extent of any cost-sharing arrangements assumed.

Reserves — In that NASA maintains no reserves for science investigations or missions, reserves must include those funds that are not allocated specifically to estimated resources, but are held against contingencies or underestimation of resources to mitigate the investigation risk. Reserves must be reported according to the proposed reserve management strategy. For example, if the reserve is divided into funds to be preallocated to the flight system and instrument payload, with another portion held at the science investigation level, specific dollar amounts to fund each must be identified.

Science-Exploration-Technology Enhancement Option (SEO) Activities --- Options for enlarging the science impact beyond the baseline investigation, such as an extended mission, guest investigator programs, general observer programs, or archival data analysis programs are termed SEO activities.

Spacecraft Bus — Spacecraft bus costs include costs incurred to design, develop, and fabricate (or procure) the spacecraft subsystems. Costs for integration and assembly are not included in this element. Component level test and burn-in is included in this cost element. System tests are included in Spacecraft IAT (see below).

Spacecraft Integration, Assembly, and Test (IAT) — Spacecraft integration, assembly and test is the process of integrating all spacecraft subsystems and payloads into a fully tested, operational satellite system. The total cost of IAT for a satellite includes research/requirements specification, design and scheduling analysis of IAT procedures, ground support equipment, systems test and evaluation, and test data analyses. Typical satellite system tests include thermal vacuum, thermal cycle, electrical and mechanical functional, acoustic, vibration, electromagnetic compatibility/interference, and pyroshock.

Tracking Services including DSN — This line item includes all costs associated with this service for the specific proposed mission profile. (Refer to *NASA's Mission Operations and Communications Services* document, in the PEA-specific Program Library.)

Part C.3: ABBREVIATIONS AND ACRONYMS

AA	Associate Administrator
a.k.a.	also known as
AM&O	Agency Management and Operations
AO	Announcement of Opportunity
AOR	Authorized Organizational Representative
BOE	Basis of Estimate
CADRe	Cost Analysis Data Requirement
CARA	Conjunction Assessment Risk Analysis
CBE	Current Best Estimate

CCR	Central Contractor Registry
CDR	Critical Design Review
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CM&O	Center Management and Operations
CNSI	Classified National Security Information
Co-I	Co-Investigator
DSN	Deep Space Network
EA	Environmental Assessment
EAR	Export Administration Regulations
EASSS	Evaluations, Assessments, Studies, Services, and Support
EBPOC	Electronic Business Point of Contact
EIS	Environmental Impact Statement
ELV	Expendable Launch Vehicle
EOL	End-of-Life
E/PO	Education and Public Outreach
ERT	Earth Resources Technology, Inc.
EV	Earth Venture
EVM	Earned Value Management
FAD	Formulation Authorization Document
FAQ	Frequently Asked Questions
FAR	Federal Acquisition Regulations
FFRDC	Federally Funded Research and Development Center
FMO	Focused Mission of Opportunity
FOV	Field of View
FY	Fiscal Year
GAO	Government Accountability Office
GDS	Ground Data System
GEO	Geosynchronous Orbit
GFE	Government Furnished Equipment
GFS	Government Furnished Service
GSFC	Goddard Space Flight Center
HBCU	Historically Black Colleges and Universities
HBZ	HUB Business Zone
HEO	Human Exploration and Operations
HEOMD	HEO Mission Directorate
HQ	Headquarters
HSPD	Homeland Security Presidential Directive
HUB	Historically Underutilized Business
HUBZone	Historically Underutilized Business Zone
IAT	Integration, Assembly, and Test
ICD	Interface Control Document
ISS	International Space Station
I&T	Integration and Test
ITAR	International Traffic in Arms Regulations
IV&V	Independent Verification and Validation

JCL	Joint Cost and Schedule Confidence Level
JPL	Jet Propulsion Laboratory
KDP	Key Decision Point
LEO	Low Earth Orbit
LOA	Letter of Agreement
LSP	Launch Services Program
MB	Megabyte
MD	Mission Directorate
MEL	Master Equipment List
MO	Mission of Opportunity
MOC	Mission Operations Center
MO&DA	Mission Operations and Data Analysis
MOS	Mission Operations Services
MOU	Memorandum of Understanding
NASA	National Aeronautics and Space Administration
NASA-STD	NASA-Standard
NEN	Near Earth Network
NEPA	National Environmental Policy Act
NFS	NASA FAR Supplement
NID	NASA Interim Directive
NISN	NASA Integrated Services Network
NLSA	Nuclear Launch Safety Approval
NMES	New Mission using Existing Spacecraft
NODIS	NASA Online Directives Information System
NOI	Notice of Intent
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NRA	NASA Research Announcement
NRP	NASA Routine Payload
NSPIRES	NASA Solicitation and Proposal Integrated Review and Evaluation System
NTRS	NASA Technical Reports Server
OCFO	Office of the Chief Financial Officer
OCT	Office of the Chief Technologist
OMI	Other Minority Institution
OSMA	Office of Safety and Mission Assurance
OSTP	Office of Science and Technology Policy
PDF	Portable Data Format
PDR	Preliminary Design Review
PEA	Program Element Appendix
PI	Principal Investigator
PIC	Procurement Information Circular
P.L.	Public Law
PM	Project Manager
PMC	Program Management Council
PMO	Partner Mission of Opportunity
POC	Point of Contact

PS	Project Scientist
PSE	Project Systems Engineer
ROSES	Research Opportunities in Space and Earth Sciences
RY	Real Year
SALMON	Stand Alone Missions of Opportunity Notice
SB	Small Business
SC	Student Collaboration
SCaN	Space Communication and Navigation
SCM	Small Complete Mission
SDB	Small Disadvantaged Business
SDVOSB	Service Disabled Veteran Owned Small Business
SE	System Engineer(ing)
SEO	Science-Exploration-Technology Enhancement Option
SI	Système Internationale (metric system)
SMA	Safety and Mission Assurance
SMD	Science Mission Directorate
SMEX	Small Explorer
SN	Space Network
S/N	Signal-to-Noise
SOC	Science Operations Center
SOW	Statement of Work
SPG	Strategic Programming Guidance
START	Standards and Technical Assistance Resource Tool
TA	Technical Authority
TMC	Technical, Management, and Cost
TRL	Technical Readiness Level
UARC	University Affiliated Research Center
URL	Uniform Resource Locator
U.S.	United States
USC	United States Code
USPI	U.S. Participating Investigator
VOSB	Veteran Owned Small Business
WBS	Work Breakdown Structure
WOSB	Women Owned Small Business

APPENDIX D

PROGRAM LIBRARY

SALMON-2 Acquisition Homepage

The SALMON-2 Acquisition Homepage may be found at <http://soma.larc.nasa.gov/SALMON-2/>.

PEA-specific Acquisition Pages for individual Program Element Appendices may be accessed from the SALMON-2 Acquisition Homepage.

SALMON-2 Program Library

PEA-specific Program Libraries for individual Program Element Appendices may be accessed from the SALMON-2 Acquisition Homepage at <http://soma.larc.nasa.gov/SALMON-2/>.

All NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents referenced in this AO may be found in the NASA Online Directives Information Service (NODIS) at <http://nodis.gsfc.nasa.gov/>.

NASA technical standards documents may be found in the public access portion of the NASA Standards and Technical Assistance Resource Tool (START) at <http://standards.nasa.gov/>. NASA technical reports may be found on the NASA Technical Reports Server (NTRS) at <http://ntrs.nasa.gov/search.jsp>.

The Federal Acquisition Regulations (FAR) are available at <http://www.acquisition.gov/far/> [updated December 12, 2014]. The Code of Federal Regulations (CFR) and the United States Code (USC) are available at <http://www.gpo.gov/fdsys/>. Executive Orders may be accessed at <http://www.archives.gov/federal-register/executive-orders/>.

The NASA FAR Supplement (NFS) may be accessed at <http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm>. NASA Procurement Information Circulars (PIC) may be accessed at <http://www.hq.nasa.gov/office/procurement/regs/pic.html>.

A Proposal Evaluation Plan Template is available at http://soma.larc.nasa.gov/StandardAO/sao_templates.html.

PEA-specific Program Libraries

The following documents are referenced in the SALMON-2 AO. If they are applicable to a specific PEA, then they may be found in the PEA-specific Program Library.

Explanatory Guide to the NASA Science Mission Directorate Educational and Public Outreach Evaluation Factors
Explanatory Guide to the NASA Science Mission Directorate Educational Merit Evaluation Factors for Student Collaboration Elements
NASA's Mission Operations and Communications Services
SMD Mission Extension Paradigm
SPD-18, Policy and Requirements for the E/PO Programs of SMD Missions
SPD-19, Meeting the 70% Joint Confidence Level Requirement in PI-led Missions

APPENDIX E

REQUIREMENTS FOR SUBSEQUENT PHASES

This appendix provides references to documents that govern subsequent phases of mission development for selected investigations. These documents may contain requirements on selected missions; however they do not place requirements on proposals submitted in response to this AO. Proposed investigations should be implementable within the program and project management environment that these documents describe. These documents may be found in the NASA Online Directives Information Service (NODIS) at <http://nodis.gsfc.nasa.gov/>.

NPR 7120.5D NID, *NASA Space Flight Program and Project Management Requirements*

NPR 7123.1A, *NASA Systems Engineering Processes and Requirements*

NPR 8705.4, *Risk Classification for NASA Payloads*

NPR 8715.3, *NASA General Safety Program Requirements*

APPENDIX F

COMPLIANCE CHECKLIST

This appendix contains a checklist with the list of items that NASA will check for compliance before releasing a proposal for evaluation. All other requirements will be checked during evaluation.

Administrative	
1. Proposal submitted through NSPIRES on time	Requirement 1
2. Meets page limits	Requirement 89
3. Meets general requirements for digital file format (single searchable, bookmarked PDF, less than 25 MB)	Requirement 91
4. Meets general requirements for display format and completeness (maximum 55 lines text/page, maximum 15 characters/inch -- approximately 12 pt font, 1 inch margins)	Requirement B-3
5. Required appendices included; no additional appendices	Requirement B-57
6. Budgets are submitted in required formats	Requirement B-53
7. All individual team members who are named on the cover page indicate their commitment through NSPIRES	Requirement B-7
8. All export-controlled information has been identified	Requirement 86
Science, Exploration, or Technology	
9. Addresses solicited science, exploration, or technology programs	Requirement 11
10. Requirements traceable from objectives to measurements to instruments to mission	Requirement 13
11. Baseline investigation and threshold investigation defined	Requirement 17
Technical	
12. Complete spaceflight mission (Phases A-F) proposed	Requirement 23
13. Team led by a single PI	Requirement 40
14. Includes commitment for E/PO program (if PEA requires)	Requirement 70
15. PI-Managed Mission Cost within cost cap (if PEA specifies a cap)	Requirement 53
16. Co-Investigator costs in budget	Requirement 66
17. Launch date prior to launch deadline (if PEA specifies a deadline)	PEA Requirement
18. Includes table describing non-U.S. participation	Requirement 81
19. Includes letters of commitment from funding agencies for non-U.S. participating institutions	Requirement 78
20. Includes letters of commitment from all U.S. organizations offering contributions	Requirement 83
21. Includes letters of commitment from all major partners	Requirement 84

APPENDIX G

REQUIREMENTS CROSSWALK

Part G.1: This appendix contains an approximate crosswalk between proposal requirements in the AO and proposal requirements in Appendix B. Proposal requirements in Appendix B expand upon the proposal requirements in the AO and provide further definition on the structure and content of the proposal. Some AO requirements do not require further definition by an Appendix B requirement. Not all possible crosswalk relations are shown.

<u>AO Reqmt</u>	<u>AO Section</u>	<u>AO Reqmt Topic</u>	<u>Appendix B Reqmt</u>
Requirement 11	5.2.1	Goals & Objectives	Requirement B-13
Requirement 13	5.2.2	Flow-down from Goals & Objectives	Requirement B-15
Requirement 14	5.2.2	Calibrate, analyze, publish, archive returned data.	Requirement B-16
Requirement 16	5.2.3	Proposed instrumentation	Requirement B-17
Requirement 26	5.3.2	Implementation approach	Requirement B-26, Requirement B-40
Requirement 27, Requirement 28	5.3.3	Management approach	Requirement B-45
Requirement 30	5.3.4	Maturation of technologies	Requirement B-27, Requirement B-41
Requirement 35	5.3.7	Critical Events	Requirement B-35, Requirement B-39
Requirement 40, Requirement 41, Requirement 42	5.4.1, 5.4.2	PI and PM roles and responsibilities	Requirement B-22
Requirement 43, Requirement 44	5.4.3	Key management qualifications	Requirement B-46
Requirement 51	5.4.6	NASA Centers compliance	Requirement B-65
Requirement 55, Requirement 56	5.5.2	Cost estimation	Requirement B-50, Requirement B-51
Requirement 59	5.5.3	Work Breakdown Structure (WBS)	Requirement B-53
Requirement 60	5.5.4	Master Equipment List (MEL)	Requirement B-69
Requirement 65, Requirement 66	5.6.2	Team Member roles and responsibilities	Requirement B-22, Requirement B-46
Requirement 73, Requirement 74	5.8	Contributions	Requirement B-61, Requirement B-62

Requirement 81	5.9.2	International participation	Requirement B-63, Requirement B-64
Requirement 82	5.9.4	Export control guidelines	Requirement B-63
Requirement 85	5.10.1.3	Team Member commitments	Requirement B-7
Requirement 86	5.10.2	Export controlled material	Requirement B-63
Requirement 89	6.2.1	Uniform proposal format	Requirement B-4, Requirement B-11, Requirement B-12
Requirement 91	6.2.3	Electronic submission of proposals	Requirement B-1
Requirement 92	6.2.3	Electronic Cover Page (NSPIRES)	Requirement B-5

Part G.2: This appendix lists those requirements that are explicitly called out for specification in the applicable PEA. The PEA will have further requirements in addition to these, and the PEA may modify other requirements found in this AO in addition to those listed here. This list may be incomplete.

Section 2.4	Goals and objectives for proposed investigations
Section 2.4	Funding available for selected investigations (including funding for Category III proposals, if applicable)
Section 3, Section 6.2.3	Proposal submittal deadline, sponsoring mission directorate and division, type of MO
Section 4.1.2	Program-specific safety, reliability, and quality assurance requirements document
Sections 4.1.2, 7.4.2	Designated NASA Center for program office
Sections 4.1.4, 5.3.2	Mission category and the payload risk classification that will be applied to selected investigations
Section 4.2.1	Additional organizations used for evaluation services and any restrictions on their participation in proposals
Section 4.2.1	Additional restrictions on participation by Aerospace in proposals
Sections 4.3.1, 5.5.1	Additional costs to be included in, and cap on, PI-Managed Mission Cost
Section 4.3.2	Additional costs to be included in Total Mission Cost
Section 4.3.3	Additional costs to be included in Enhanced PI-Managed Mission Cost
Section 4.3.4	Any constraints on funding profile, selection date, and launch readiness date
Sections 4.6, 5.1.3, 5.3.5	Identification of any NASA-provided launch services
Section 5.1	Identification of permitted categories of missions of opportunity
Section 5.1.1	Endorsement date for partner missions of opportunity
Section 5.1.1	Any investigation date constraints
Section 5.1.2	Decision requirement date for new missions using existing spacecraft

Section 5.1.3	Launch date constraints for small complete missions
Section 5.1.3	Access to space constraints for small complete missions
Section 5.3.1	Determination to use a two-step competitive process
Section 5.3.2	Broadening of allowable platforms beyond spacecraft
Section 5.3.4, Appendix B Section F.3	Deadline for technology maturation to TRL 6 if other than KDP-C, including OCT sponsored investigations
Section 5.3.5	Charge, if any, for NASA insight for non-NASA launch services
Section 5.4.5	Schedule requirements
Section 5.7.1	E/PO guidance for non-SMD sponsored investigations
Section 5.7.2	Allowability and constraints for student collaborations
Section 5.8	Constraints on contributions, if any
Section 6.1.1	Existence and logistics for a preproposal conference
Section 6.1.2	Deadline for a notice-of-intent to propose
Section 6.1.4	Links to any PEA-specific acquisition homepage and program library
Section 6.1.5	Contact information for the PEA-specific point-of-contact
Section 6.2.1	Modification of any proposal general content or structure requirements
Section 7.1	Identification of selection official

APPENDIX H

CERTIFICATIONS

Included for reference only. Submission of the signed proposal including Section V of the Proposal Summary Information certifies compliance with these certifications.

Assurance of Compliance with the National Aeronautics and Space Administration Regulations Pursuant to Nondiscrimination in Federally Assisted Programs

The (*Institution or organization on whose behalf this assurance is signed, hereinafter called "Applicant."*)

HEREBY AGREES THAT it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352), Title IX of the Education Amendments of 1972 (20 USC 1680 *et seq.*), Section 504 of the Rehabilitation Act of 1973, as amended (29 USC 794), and the Age Discrimination Act of 1975 (42 USC 16101 *et seq.*), and all requirements imposed by or pursuant to the Regulation of the National Aeronautics and Space Administration (14 CFR Part 1250) (hereinafter called "NASA") issued pursuant to these laws, to the end that in accordance with these laws and regulations, no person in the United States shall, on the basis of race, color, national origin, sex, handicapped condition, or age be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant receives Federal financial assistance from NASA; and HEREBY GIVES ASSURANCE THAT it will immediately take any measure necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the Applicant by NASA, this assurance shall obligate the Applicant, or in the case of any transfer of which the Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the Applicant for the period during which it retains ownership or possession of the property. In all other cases, this assurance shall obligate the Applicant for the period during which the Federal financial assistance is extended to it by NASA.

THIS ASSURANCE is given in consideration of and for the purpose of obtaining any and all Federal grants, loans, contract, property, discounts or other Federal financial assistance extended after the date hereof to the Applicant by NASA, including installment payments after such date on account of applications for Federal financial assistance which were approved before such date. The Applicant recognizes and agrees that such Federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Applicant, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign on behalf of the Applicant.

Certification Regarding Debarment, Suspension, and Other Responsibility Matters
Primary Covered Transactions

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 14 CFR Part 1265.

A. The applicant certifies that it and its principals:

1. Are not presently debarred, suspended, proposed for debarment, declare ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
2. Have not within a three-year period preceding this application been convicted or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
3. Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph A.(b) of this certification;
4. Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or Local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

C. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion -- Lowered Tier Covered Transactions (Subgrants or Subcontracts)

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principles is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department of agency.
2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Certification Regarding Lobbying

As required by S 1352 Title 31 of the U.S. Code for persons entering into a grant over \$100,000, the applicant certifies that:

1. No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, in connection with making of any Federal grant, the entering into of any cooperative, and the extension, continuation, renewal, amendment, or modification of any Federal grant;
2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting an officer or employee of any agency, Member of Congress, or an employee of a Member of Congress in connection with this Federal grant, the undersigned shall complete Standard Form -- LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subgrants, contracts under grants, and subcontracts), and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by S1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)

NNH12ZDA0060-EV11
Program Element Appendix (PEA) J:
EARTH VENTURE INSTRUMENT-1

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NNH12ZDA0060-EV11
PROGRAM ELEMENT APPENDIX (PEA) J:
EARTH VENTURE INSTRUMENT-1

1 BACKGROUND

1.1 Programmatic Overview

The National Aeronautics and Space Administration (NASA) Science Mission Directorate (SMD) Earth Science Division's Earth Venture (EV) mission portfolio is an element within the Earth System Science Pathfinder (ESSP) Program. Earth Venture missions consist of a series of regularly solicited, competitively selected, cost and schedule constrained Earth science investigations as recommended by the most recent National Research Council's decadal survey in Earth science, *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (The National Academies Press, 2007), available at http://www.nap.edu/catalog.php?record_id=11820.

The goal of NASA's Earth Venture mission portfolio is to provide frequent flight opportunities for high quality, high value, focused Earth science investigations that can be accomplished under a not-to-exceed cost cap and that can be developed and flown relatively quickly, generally in five years or less. The investigations will be principal investigator (PI)-led and will be selected through an open competition to ensure broad community involvement and encourage innovative approaches.

The programmatic objectives of the Earth Venture mission portfolio are to implement missions that will:

- advance scientific knowledge of Earth science processes and systems;
- add scientific data and other knowledge-based products to data archives for all to access;
- result in scientific progress and results published in the peer-reviewed literature to encourage, to the maximum extent possible, the fullest commercial use of the knowledge gained;
- provide opportunities to expand the pool of well-qualified Principal Investigators and Project Managers for implementation of future NASA missions;
- implement technology advancements accomplished through related programs; and
- communicate scientific progress and results through popular media, scholastic curricula, and outreach materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

The EV missions will accomplish high quality Earth science investigations utilizing efficient management approaches to contain mission cost through commitment to, and control of, design, development, and operations costs. The missions also seek to enhance public awareness of and appreciation for Earth science by incorporating educational and public outreach activities as integral parts of the investigations.

This solicitation calls for proposals for complete PI-led science investigations requiring spaceflight instrument development. The term “complete” encompasses investigation phases from project initiation, through instrument development and science operations, to scientific analysis of space based data. When deployed on a satellite selected by NASA, these spaceflight instruments will be used to conduct innovative, integrated, hypothesis or scientific question-driven investigations addressing pressing Earth system science issues.

This solicitation solicits investigations addressing any of the science focus areas in NASA’s Earth Science program (see Section 2.1 for a description of the focus areas). Investigations may target any Earth science question or issue in order to advance the strategic goals outlined in Section 2.1, answer any of the science questions for Earth Science from Appendix 1 of the *2010 Science Plan for NASA’s Science Mission Directorate* (hereafter the *2010 Science Plan*; available at <http://science.nasa.gov/about-us/science-strategy/>), or address any of the science area objectives for Earth Science also from Appendix 1 of the *2010 Science Plan*.

Investigations that address NASA goals in other areas such as heliophysics, astrophysics, or planetary science are not solicited in this solicitation. Priority will be given to cost-effective, innovative instruments with demonstrable reliability, rather than ones with excessive technology development requirements. Missions that focus on establishing entirely new research avenues or demonstrating key applications-oriented measurements are solicited.

A key to the success of the Earth Venture (EV) portfolio will be maintaining a steady and predictable stream of opportunities for community participation and innovative idea development. This requires that strict schedule and cost guidelines be enforced on the selected EV missions and mission teams.

1.2 Earth Venture Background

The National Research Council’s decadal survey in Earth science recommended that NASA maintain a line of competitively selected, moderate size missions and opportunities in the Earth Venture mission portfolio. The first airborne science investigations funded under the Earth Venture element (called EV-1) are now in the beginning stages of implementation. The second Earth Venture element for cost constrained stand alone space missions (called EV-2) is now being competed, with selection expected in 2012. Earth Venture is being implemented in the broader context of NASA’s Earth Science program and is intended to result in more frequent opportunities than afforded by the strategic and directed missions outlined in the decadal survey.

The following foci have been identified for the Earth Venture-class missions:

- measurement and observation innovations;
- demonstration of innovative ideas allowing the use of existing moderately higher-risk technologies or approaches;
- establishment of new research avenues; and
- possible demonstration of key application-oriented measurements.

The selection criteria for EV missions are based primarily on the direct science return from the measurement.

The National Research Council's decadal survey in Earth science and applications has recommended three types of Earth Venture-class missions. Through the Earth Venture mission portfolio, NASA intends to obtain a mix of suborbital, instrument, and complete spaceflight mission investigations. To achieve this mix, three different kinds of solicitations are being pursued under the Earth Venture-class line.

- *EV-Odd* (i.e., EV-1, 3, 5, ...). These solicitations call for proposals for complete suborbital, PI-led investigations to conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The first of these was EV-1, whose selectees were announced in May 2010. The next solicitation in this series is anticipated in 2013. Not solicited in this solicitation
- *EV-Even* (i.e., EV-2, 4, 6, ...). These solicitations call for proposals for complete PI-led spaceflight missions to conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The EV-2 solicitation was the first of these, with the selections to be announced in early 2012. The next solicitation in this series is anticipated in 2015. Not solicited in this solicitation
- *EV Instrument* (e.g., EVI-1, 2, 3, ...). These solicitations will call for developing instruments for participation on a NASA-arranged spaceflight mission of opportunity to conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The NASA funded PI will retain a central role on the instrument or instrument package development, integration and testing, calibration, and science operations. This is the first solicitation in this series, with the first selection expected in 2012. Subsequent solicitations in this series are anticipated every 15-18 months thereafter (or shortly after the selection announcement of the previously solicited EVI). Solicited in this solicitation.

All Earth Venture-class spaceflight missions require a schedule for launch (or delivery for platform integration in the case of EVI) within five years of project initiation and projects are cost-capped. The Earth Venture class is not intended to be a mechanism for accelerating the implementation of decadal survey missions. However, it is also possible and acceptable that an instrument selected and developed through this solicitation could address significant portions of missions or measurements identified by the decadal survey.

This is the first solicitation in the Earth Venture series soliciting for instruments to be provided for Missions of Opportunity (MOs). The next solicitation in this series is anticipated not less than one year following the release of EVI-1 and not before the selection announcement for EVI-1.

1.3 Overview of this Program Element Appendix

NASA issues this Program Element Appendix (PEA) as an appendix of the Second Stand Alone Missions of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO) for the purpose of soliciting proposals for Mission of Opportunity (MO) investigations to be

implemented through the Earth Venture Instrument (EVI) portion of the Earth System Science Pathfinder (ESSP) Program. All investigations proposed in response to this solicitation must support the goals and objectives of the ESSP Program and the EVI element (Section 2.1), must be implemented by Principal Investigator (PI)-led investigation teams (Section 5.4 of the SALMON-2 AO), and must result in the provision of a flight qualified spaceflight instrument or instrument package ready for integration to a spacecraft (Phase A-C), technical support for integration onto a NASA-determined spacecraft (Phase D, see Section 4.4.1), and on-orbit operation of the instrument and delivery of science quality data (Phase E), as described in Section 4.1 of the SALMON-2 AO.

Proposals submitted in response to this PEA will be evaluated and selected through a single step competitive process. As the outcome of this single step, NASA intends to select nominally one proposed investigation to proceed to mission development for flight and operations. If numerous proposals are deemed selectable such that combined costs are within the available funding (as defined in Section 4.4.1), NASA may select more than one investigation in response to this solicitation.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO contains additional requirements on the format and content of the proposals. Documents, available in the EVI Program Library at http://essp.larc.nasa.gov/EV-I/evI_ProgramLibrary.html are intended to provide guidance for investigations selected; they are specifically not intended to impose requirements on proposals.

1.4 NASA On-line Document Information System

NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents are available through the NASA On-line Document Information System (NODIS) at <http://nodis3.gsfc.nasa.gov/>.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 NASA Earth Science Goals

One of NASA's strategic goals is to "Advance Earth System Science to meet the challenges of climate and environmental change." Further information on NASA's strategic goals may be found in the most recent version of the *NASA Strategic Plan*, available at <http://www.nasa.gov/about/budget/>, and in the *2010 Science Plan for NASA's Science Mission Directorate*, available at <http://science.nasa.gov/about-us/science-strategy/>.

From space, NASA satellites can view the Earth as a planet and enable its study as a complex, dynamic system with diverse components: the oceans, atmosphere, continents, ice sheets, and life itself. The nation's scientific community can thereby observe and track global-scale changes connecting cause to effects, study regional changes in their global context, and observe the role that human civilization plays as a force of change. Through partnerships with agencies that maintain forecast and decision support systems, NASA improves national capabilities to predict climate, weather, and natural hazards; manage resources; and craft environmental policy.

NASA's Earth science research aims to acquire deeper scientific understanding of the components of the Earth system, their interactions, and the consequences to life due to changes in the Earth system. These interactions occur on a continuum of spatial and temporal scales ranging from short-term weather to long-term climate and motions of the solid Earth and from local and regional to global changes. They involve multiple, complex, and coupled processes that affect climate, air quality, water resources, biodiversity, and other features that allow our Earth to sustain life and civilization. A challenge is to predict changes that will occur in the next decade to century, both naturally and in response to human activities. This requires a comprehensive scientific understanding of the entire Earth system, in particular how its component parts and their interactions have evolved, how they function, and how they may be expected to further evolve on all time scales.

NASA's Earth Science program advances knowledge of the integrated Earth systems and strives to advance goals in six Science Focus Areas and their component disciplinary programs. The six focus areas and their main aims as articulated in the *2010 Science Plan* are as follows:

- **Atmospheric Composition:** understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition;
- **Weather:** enabling improved predictive capability for weather and extreme weather events;
- **Carbon Cycle and Ecosystems:** quantifying, understanding and predicting changes in Earth's ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity;
- **Water and Energy Cycle:** quantifying the key reservoirs and fluxes in the global water cycle and assessing water cycle change and water quality;
- **Climate Variability and Change:** understanding the roles of ocean, atmosphere, land, and ice in the climate system and improving predictive capability for future evolution; and
- **Earth Surface and Interior:** characterizing the dynamics of the Earth surface and interior and forming the scientific basis for the assessment and mitigation of natural hazards and response to rare and extreme events.

NASA's activities encompass the global atmosphere; the global oceans, including sea ice; land surfaces, including snow and ice; ecosystems; and interactions between the atmosphere, oceans, land, and ecosystems, including humans. A key strategic element is sustained simultaneous observation to unravel the complexity of the global integrated Earth system.

2.2 Accommodation of EV Instruments

The objective of this solicitation is to select an investigation(s) where an instrument(s) is built and deployed on an existing planned spacecraft followed by production of high quality and highly useful Earth Science data from that instrument. These investigations/instruments will be proposed without a firm identification of the spacecraft to accommodate these instruments. Therefore, selection of proposals from this solicitation will balance the "accommodability" of the

proposed instruments with the value of the science to be returned from the selected investigations. Many satellites that will be launched to orbits appropriate for observations of the Earth System are expected to have capacity to accommodate additional instruments. These spacecraft could be developed by NASA (including the International Space Station), other U.S. agencies, national space agencies other than NASA, or commercial vendors. In order to take advantage of excess payload capacity on any of these platforms, NASA is planning to build instruments to have available, or nearly available, for inclusion on these various spacecraft. The available capacity including size, weight, power, thermal control, pointing stability, pointing ability, orbits, and data rates for each potential platform will vary, but in general the platform requirements and capacities will be defined by their primary payloads. The instruments provided through this PEA will have to work within the available resources. Hence, there will be some constraints on the specifications of any instruments potentially selected for development through this EV Instrument-1 PEA. Proposed instruments that cannot meet many of the requirements anticipated for most potential platforms will be seen as a higher risk for accommodation than those that have higher specification margin.

2.3 NASA Management of the Earth Venture Program

The selected investigation(s) will be managed by the Earth System Science Pathfinder (ESSP) Program. The Associate Administrator for SMD has established an ESSP Program Office (ESSP PO) at the NASA Langley Research Center (LaRC) to be responsible for project oversight. The ESSP Program Manager at NASA LaRC reports to the Associate Director for Flight Programs within the Earth Science Division at NASA Headquarters. Additional details about the program office staffing, structure, and management approach can be found in the *ESSP Program Plan*, available through the EVI Program Library. There are appropriate protective firewalls between the ESSP Program Office and the rest of LaRC, allowing investigators from LaRC to propose in response to this PEA. ESSP PO will manage the EVI investigations under the requirements of NPR 7120.5D NID, *NASA Space Flight Program and Project Management Requirements*, as described in Section 4.1.2 of the SALMON-2 AO.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

This solicitation is an appendix to the NASA Second Stand Alone Mission of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO). The SALMON-2 AO provides the overall structure and guidelines for several types of mission of opportunity solicitations. Each new opportunity is announced with a Program Element Appendix (PEA). This document is such a PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com> and at <http://go.nasa.gov/SALMON2-AO>.

This PEA solicits science investigations that include the development of instruments to be provided to and integrated with yet-to-be-identified space platforms for obtaining Earth science observations.

Evaluation and selection will be done using a single step selection process; no competitive Phase A (Step 2) or down selection is planned. Normal instrument Phase A activities will be conducted by the selected investigation team or teams following selection.

The following schedule applies to this PEA.

- A Preproposal Workshop will take place in association with this solicitation. Further information will be available at the Earth Venture Instrument PEA Additional Information Homepage (see Section 7 of this PEA) prior to the Preproposal Workshop.
- Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA. The period for questions will close two weeks before the proposal due date.
- A Notice of Intent (NOI) to propose to this announcement is extremely valuable to NASA for purposes of planning the proposal evaluation and peer reviews, and, therefore, is encouraged. NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Section 6.1.2 of the SALMON-2 AO provides information on electronic NOI submission through NSPIRES.
- All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.
- NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four months following receipt of the Statement of Work, as set forth in Section 6.3.1 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Propose

Refer to Section 4.2 of the SALMON-2 AO for the rules on participation policy. For this particular PEA, NASA will place full or partial limitations (as described in the SALMON-2 AO) on organizations that will be involved in the evaluation process. Earth Resources Technology Inc. (ERT) is subject to the “Full Limitation” as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on the Aerospace Corporation for EVI-1.

4.2 Type of Mission of Opportunity

In the context of the SALMON-2 AO, this program element appendix is a Focused Mission of Opportunity (FMO). A FMO is one that addresses a specific, NASA-identified flight opportunity that fulfills the solicited objectives and includes all of the elements specified in this document and in Appendix B of the SALMON-2 AO.

The investigation PI is responsible for conducting the proposed science investigation which includes, but is not limited to: (i) development and delivery of the instrument or instrument package; (ii) working with NASA to integrate the instrument on the chosen platform; (iii) commissioning, validating, and operating the instrument and ground systems on-orbit in order to carry out the proposed science investigation; (iv) preparing and delivering appropriate data analysis software, including required calibration data, analyzing the data, archiving the data in a NASA chosen Distributed Active Archive Center (DAAC), and reporting the results of the science investigation in the science literature.

4.3 Science Requirements and Constraints

The science requirements were fully described in Section 2. Any appropriate science question relevant to Earth system science can be addressed with the proposed investigations. Section 2 provides the basis for the evaluation of intrinsic science merit as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside Earth system science as described in Section 2 are not solicited through this call.

Requirement J-1. Proposals shall address appropriate science questions relevant to Earth system science as described in Section 2 of this PEA.

Requirement J-2. Each proposal shall clearly define its science question or questions, shall demonstrate how the science questions map into high-level science requirements, and shall show how the science requirements subsequently map into the measurement requirements.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement J-3. Each proposal shall clearly state the baseline and threshold requirements for the performance of the instrument, the prime mission lifetime for operation of the instrument, and range of satellite orbits acceptable or required for deployment of the instrument.

Requirement J-4. Proposals shall designate all Co-Is, describe the role of each Co-I in the development of the mission, and justify the necessary nature of the role; see Section 5.6 of the SALMON-2 AO.

Each observation from space has natural synergies with other observations. Some proposed observations may either require or desire other observations in order to better address the science questions as proposed for the investigation. Some of these observations may be currently existing or planned either from other NASA missions or from missions by other U.S. or international agencies. Proposers are expected to clearly state any dependencies for other data sets, what assumptions are made on the likelihood that these observations will exist during potential time frames for operation of their proposed investigations, and what the implications are if those observations do not exist.

Requirement J-5. Each proposal shall clearly outline which ongoing or planned set of observations, if any, are required for the proposed investigation to achieve its baseline mission science investigation. The proposal shall describe how the high-level science requirements will be impacted if such observations do not exist when the proposed investigation is in operation.

Most NASA Earth science observations from space require stringent and well-defined calibration and validation plans. NASA expects each proposal to fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the selected PI-led investigation, the proposals should provide information about the commitment to

funding for those data in the time line of 5-10 years after selection of the investigation and describe the implications to meeting the science requirements if such data do not exist.

Requirement J-6. Each proposal shall fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the selected PI-led investigation, the proposals should provide information about the expectations for available calibration and validation instruments and/or data in the time line of 5-10 years after selection of the investigation and describe the implications to meeting the science requirements if such activities do not exist.

4.4 Cost and Schedule Requirements and Constraints

4.4.1 Cost Requirements and Constraints

The PI-Managed Mission Cost cap for an Earth Venture Instrument (EVI) investigation is \$90M in Fiscal Year (FY) 2014 dollars.

NASA expects to select nominally one EVI instrument; if multiple selectable instruments are proposed with combined costs within the available funding (\$90M), NASA may select more than one proposed investigation.

Each selected investigation is PI-Managed, and the PI will be responsible for defining and controlling the costs within the proposed budget for each phase of the investigation. Because NASA will be arranging the spacecraft to be used by the selected investigation, some costs cannot be defined and controlled by the PI, and these costs will be outside the constrained PI-Managed Mission Cost. This section identifies those costs which are constrained within the PI-Managed Mission Cost and those where NASA requires planning budgets that are outside the constrained PI-Managed Mission Cost. A summary of budgeted costs that are and are not to be included in the PI-Managed cost cap is listed in Table 1.

Costs that are within the PI-Managed Mission Cost include: instrument delivery ready for integration onto the selected platform (Phases A-C); development and delivery of functional algorithms and ground processing system (Phases B-D); supporting a science team that will contribute directly to the successful implementation of the investigation (Phases A-F); required calibration and validation activities (Phases C-E); operations, product generation, and data analysis during the proposed prime mission lifetime of the investigation (Phases E); and close out of the investigation once the investigation has been concluded (Phase F). The PI-Managed Mission Cost also includes the cost of the science team and of key management and engineering staff during Phase D as this is not expected to be dependent on the final platform of the selected investigation. For support of the science team and key management and engineering during Phase D, a two year duration should be assumed for budgeting purposes.

It is expected that once an appropriate platform is determined (preferably before the Preliminary Design Review) minor changes to the selected instrument will be required. Appropriate budget margin should be planned to account for such changes.

Costs that are outside the PI-Managed Mission Cost include integration to the NASA selected platform (Phase D); and investigation costs during any potential gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D).

For planning purposes, the proposal must include estimates of budgets for Phase D (nominally two years) for costs that would be outside the PI-Managed Mission Cost identified above for Phase D. It is understood that the final Phase D cost will be dependent on the selected platform for the instrument and the actual time frame for each development phase.

NASA also requires proposals to include plans and planning budgets that estimate the minimum costs for the project if there is a gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D). These “gap planning” budgets should be on a per-year basis up to a maximum of four years. The costs for both of these planning budgets are outside of the PI-Managed Mission Cost.

Portion of the Investigation	Within PI-Managed Costs	Outside PI-Managed Costs
Phase A	X	
Phase B	X	
Phase C	X	
Investigation Costs during a potential gap between completion of instrument and start of integration (planning budget up to 4 years, on a per-year basis)		X
Science Team activity within Phase D	X	
Key management and engineering staff during Phase D (Project manager, instrument manager, systems engineer, etc)	X	
Integration and test to selected platform (within Phase D) (planning budget nominally 2 years)		X
Cal/Val planning (all phases)	X	
Post-launch instrument commissioning activity (within Phase D)	X	
Phase E	X	
Phase F	X	
Cost for access to space		X
Core E/PO program,	X	
Student Collaboration (SC) (optional)	X – any SC cost above 1% of the PI-Managed Mission Cost	X - Up to 1% of the PI-Managed Mission Cost

Table 1: List of which portions of the investigation are within and outside the PI-Managed Mission Cost. Budgets for both are required in each proposal.

The ESSP Program's planning budget can accommodate a selection at the cost cap with a typical funding profile over a nominal five year development period for instrument delivery. Proposers should propose a funding profile that is appropriate for their investigation. Cost proposals whose requested funding profile significantly differs from the ESSP Program's planning budget for EVI-1 may be difficult to accommodate, and NASA cannot guarantee that the proposed funding profile can be accommodated within the ESSP Program's budget. The inability of NASA to accommodate the requested funding profile may be a reason for nonselection of a proposal. A final funding profile for the selected mission will be negotiated between the ESSP Program and the selected investigation team.

Requirement J-7. Proposals shall be for complete investigations including Phases A-F.

Requirement J-8. The proposed PI-Managed Mission Cost shall be no more than \$90M in FY 2014 dollars. The PI-Managed Mission Cost excludes the integration of the instrument to the selected platform, but includes proposed science team and key management and engineering staff activity in Phase D. Proposals shall assume two years for Phase D.

Requirement J-9. Proposals shall include detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Mission Cost (see Table 1).

Requirement J-10. Proposals shall include integration plans and planning budgets that occur during Phase D, with the assumption that this phase will take two years. With the exception of the PI-Managed science and engineering cost for Phase D identified in Requirement J-8, these costs are outside the PI-Managed Mission Cost.

Requirement J-11. Proposals shall include plans and planning budgets for the required costs to minimally support the project and science during a potential gap between instrument delivery (end of Phase C) and the start of integration with the spacecraft (start of Phase D). These budgets should be on a per year basis for up to four years. These costs are outside the PI-Managed Mission Cost.

4.4.2 Schedule Requirements and Constraints

Each selected investigation under the EVI solicitation will be expected to deliver an instrument that can be integrated onto a selected platform by September 30, 2017. Nominally, this will span the years of FY 2013-FY 2017. This is expected to cover development Phases A through C. Proposals that include a more rapid instrument development timeline may be selected, provided the required budget phasing can be accommodated by NASA.

It is expected that once an appropriate platform is determined, preferably before the Preliminary Design Review, minor changes to the selected instrument will be required. Appropriate schedule margin should be planned to account for such changes.

Requirement J-12. Proposals shall include a development schedule that delivers an instrument for integration onto the selected platform no later than September 30, 2017.

4.5 Technical Requirements and Constraints

4.5.1 Science Instrument System

Because there is no defined platform that directly limits the design of the proposed instrument characteristics and observing strategy, this PEA does not list specific requirements for mass, instrument dimensions, power consumption, data rate requirements, platform stabilization requirements, observational geometry requirements, launch vibration constraints, or desired orbit. However, all of these characteristics must be well characterized and clearly stated within the proposal in order for NASA to determine the feasibility of finding an appropriate platform in the near future to deploy any potential selected instrument.

Instruments that have less stringent and more easily accommodated requirements will be considered as more desirable for selection, providing they return high value science, as they are more flexible in being accommodated by the range of potential platforms available in the near future.

Requirement J-13. Proposals shall clearly state the proposed instrument mass, volume dimensions, power requirements, platform stabilization requirements, thermal requirements, observational geometry requirements, launch vibration constraints, electromagnetic interference/electromagnetic compatibility (EMI/EMC) requirements, data rate requirements, and all other requirements (or constraints, preferences, etc.) that the instrument places on the platform for accommodation, launch, deployment, operations, etc.

Requirement J-14. Proposals shall clearly state the desired and acceptable orbits and operational constraints (e.g., duty cycle or observational cadence) where useful data can be obtained and describe the relative scientific merits of each possible orbit.

4.5.2 Payload Risk Classification

This opportunity solicits proposals for science investigations requiring the development and operation of space-based instruments, designated as Class C (medium priority, medium risk, less than two years primary mission timeline as defined in NPR 8705.4, *Risk Classification for NASA Payloads*) on a platform to be identified by NASA at a later date.

Requirement J-15. If an investigation requires two or more years to meet the science requirements, the proposal must demonstrate how the instrument will meet that time requirement. If any requirements to the instrument that are more stringent than Class C are needed, they must be clearly described in the proposal.

Proposals for Class D instruments will be considered nonresponsive to this solicitation.

4.5.3 End-of Mission Spacecraft Disposal

Section 5.3.10 of the SALMON-2 AO discusses the requirements related to end-of-mission spacecraft disposal for Partner Missions of Opportunity and hosted payloads where the PI is not responsible for the host mission. For these proposals, information shall be included regarding the instrument's plan for passivation at the end of operations or in preparation for end-of-mission

disposal. In addition, information shall be provided identifying instrument system components expected to survive Earth reentry as the post-mission disposal method. This will allow NASA to remain in compliance with NPR 8715.6A, *NASA Procedural Requirements for Limiting Orbital Debris*, and NASA-STD-8719.14, *Process for Limiting Orbital Debris*.

Requirement J-16. Proposals shall describe the instrument's passivation plans at end-of-mission and identify instrument components anticipated to survive Earth reentry. This supersedes Requirement 39 in the SALMON-2 AO.

4.5.4 Instrument to Platform Interfaces

NASA has begun the process of cataloguing the potential platforms that will exist over the next decade with capacity to accommodate a potential EVI Instrument. The goal of this activity is to document, as a service to both NASA and all who are interested in potential integration of instruments on available payloads, the types of opportunities that exist and the current interfaces and constraints that exist for each potential platform. It is also desired that, as much as possible, agreements can be reached as to potential common instrument interfaces for many of these potential platforms. Documentation of this Common Instrument Interface (CII) work will be available through links in the EVI Program Library.

One result of this work is to determine the relative probabilities of NASA identifying a feasible opportunity platform for any potential or proposed EVI instrument. A proposed instrument with a high probability of being compatible with several potential platforms is more likely to be selected than an instrument with less flexible accommodation and orbit requirements (see Section 6.2).

The International Space Station (ISS) may be able to accommodate instruments with higher requirements for mass, volume dimensions, power, and thermal control. Proposers should state whether the ISS is a potential platform for integration of that instrument and show what the tradeoffs are of using the ISS orbit vs. other orbits. Any proposed instrument that is appropriate for the ISS should plan on completing its primary mission by 2020 as NASA has current plans to support the ISS only up to that time.

Proposals may include information on any research the proposing team has done relative to potential payload accommodations for their proposed instrument. This is not a requirement for any proposal. However, such information can serve to demonstrate to NASA the potential of finding one or more opportunities for accommodating the proposed instrument. If a proposal includes such information, effort should be made to address all known integration criteria and make clear which integration criteria have not been completely researched. Failure to include such research will not be counted against a proposal in review. Inclusion of such information has the potential to support the arguments within a proposal that the instrument has an acceptable chance of being integrated on a platform within an appropriate time frame.

4.5.5 NASA Earth Science Data policy

4.5.5.1 Data Analysis

The PI will be responsible for analysis of the mission data necessary to complete the proposed science objectives, for archiving the data in the NASA selected DAAC for public use, and for timely publication of initial scientific data in refereed scientific journals, as part of their mission operations (Phase E) or post-mission activities. Any science studies with the archived data sets beyond the PI-led team's proposed science investigation will be solicited and selected by NASA in subsequent NASA solicitations through the Research Opportunities in Space and Earth Sciences (ROSES) NASA Research Announcement.

Requirement J-17. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final on-orbit calibration and validation of the measurements.

Requirement J-18. Proposals shall clearly present a plan for analysis of the mission data leading to completion of the proposed science investigation and achieving the identified investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.5.5.2 Data Rights

By NASA policy, all science data returned from NASA missions are made available immediately in the public domain. Following a postflight checkout period, all data will be made available to the user community. There shall be no period of exclusive access. The principal investigator will propose the data product latency period for standard products listed in the proposal, and a justification for it must be demonstrated. Barring exceptional circumstances, data product latency may not exceed six months.

Requirement J-19. Proposals shall include a clear commitment to minimizing the latency for data products. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.5.5.3 Delivery of Data to Archive

During Phase A, NASA will assign a data center, e.g., one of the Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive centers (DAACs), to be the data archive for the selected mission; proposals should not be tailored to one specific data center. Information on EOSDIS and the DAACs is available at <http://esdis.eosdis.nasa.gov/eosdis/overview.html> and <http://esdis.eosdis.nasa.gov/dataaccess/datacenters.html>.

Mission data will be made fully available to the public by the investigator team in usable form, in the minimum time necessary and, barring exceptional circumstances, within six months following its collection. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to making it fully

available. By the investigation closeout, the investigation will deliver to the NASA-assigned data center all data products, along with the scientific algorithm software, coefficients, ancillary data used to generate these products, and the algorithm and calibration documentation.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in-flight), documentation, related software, and/or other tools or parameters that are necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of the appropriate NASA data archive. For information on NASA Earth Science data policy, nomenclature, standards, and EOSDIS, see <http://science.nasa.gov/earth-science/earth-science-data/>. Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the capped PI-Managed Mission Cost.

Requirement J-20. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving shall be described. The science products (*e.g.*, flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the formats and standards to be used, selected from the published list of approved NASA Earth Science Data System Standards (<http://www.esdswg.org/spg/docindexfolder/>). It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community. The plan shall conform to the NASA Earth Science Data and Information Policy (see <http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/>). This supersedes Requirement B-19 in Appendix B of the SALMON-2 AO

4.6 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are specified in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.4.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirement and constraints for that specific solicitation, including the sponsoring NASA Headquarters (HQ) mission directorate and division, the type of MO, the cost cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2,

the cost cap is specified in Section 4.4.1, and the schedule constraint is specified in Section 4.4.2.

- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. The NASA Center for program office is specified in Section 2.3. There is no program-specific safety, reliability, and quality assurance document.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the payload risk classification is specified in Section 4.5.2.
- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation by Aerospace in proposals. There are no additional restrictions on participation by Aerospace in proposals.
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Mission Cost, the Total Mission Cost, and the Enhanced Mission Cost. For this PEA, that information is specified in Section 4.4.1.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.4.1 and 4.4.2.
- Section 4.6 of the SALMON-2 AO states that each PEA will identify any NASA-provided launch services. For this PEA, NASA plans for access to space are discussed in Section 2.2.
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Section 3 a two-step competitive process is not being used.
- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an E/PO program that is consistent with SMD policy is required. This PEA so states, and Requirements 68, 69, and 70 of the SALMON-2 AO apply to this PEA.
- Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA
- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by SMD and it does not permit contributions of funding from SMD programs other than the funding offered through this PEA.
- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection official. This PEA identifies the Selection official in Section 6.2.

4.7 Exceptions to General SALMON-2 Requirements

This PEA contains the following exceptions to the SALMON-2 proposal preparation and submission requirements described in the SALMON-2 AO.

- Proposals or portions of proposals requesting NASA funding shall report proposal costs in Fiscal Year 2014 dollars as well in Real Year (RY) dollars. The former is for determining

compliance with the PI-Managed Mission Cost cap requirement. The latter is for NASA SMD budget planning. This instruction supersedes the request for costs only in RY dollars described in Appendix B of the SALMON-2 AO including Table B-4.

- Section 4.5.5 of this PEA provides data policies and supersedes Section 4.4 of the SALMON-2 AO.
- Proposals shall not include a plan or a budget for science-exploration-technology enhancement options (SEOs); this supersedes Section 5.2.5 of the SALMON-2 AO.
- Section 4.5.3 provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO.

5 PROPOSAL PREPARATION AND SUBMISSION

5.1 Proposal Content Requirements

Requirement J-21. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO.

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA reviewers.

5.2 Proposal Submission Requirements

Requirement J-22. Proposals must be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only.

Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement J-23. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

5.3 Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this appendix, or in the documents available through the EVI Program Library, should be sent to the E-mail address for questions listed in Section 7 of this PEA. When appropriate, responses will be posted on the website also listed in Section 7 of this PEA.

The deadline for receipt of questions is two weeks before the proposal due date listed in Section 7 of this PEA.

6 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

In addition to the evaluation factors given in Section 7.2 of the SALMON-2 AO, the evaluation of scientific merit also includes the following factor:

- Factor A-2, programmatic value of the proposed investigation, also includes the extent to which the proposed science investigation addresses unique science areas that are not being addressed by other missions (both NASA and non-NASA missions) expected to be in operation 5 to 10 years from the start of the proposed investigation.

In addition to the evaluation factors given in Section 7.2 of the SALMON-2 AO, the evaluation of technical implementation merit also includes the following factors:

- Factor B-2, probability of technical success, also includes the maturity of the design or the demonstration of a clear path to achieve the necessary maturity.
- Factor B-3, merit of the data and/or sample analysis plan, also includes the quality of the plans for calibration and data archiving, including development of a data pipeline.

The review panel evaluating the third evaluation criterion; technical, management, and cost (TMC) feasibility of the proposed investigation, including cost risk, will also provide comments to NASA regarding the extent to which the proposed instrument is compatible with potential satellite platform interfaces and operations. These comments will not contribute to the TMC feasibility risk rating.

After the evaluation, but prior to the selection decision, NASA will perform an accommodation study of selectable proposals to assess the extent to which the proposed instrument is compatible with potential satellite platform interfaces and operations.

6.2 Selection Process

After the review by the AO Steering Committee, the final evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the selection(s). As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency, including the Director of the Earth Science Division, concerning the selections.

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among top-rated proposals, including, but not limited to, planning and policy considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the mission directorate(s). For this EVI selection,

these factors also include the likelihood that the proposed instrument can be accommodated on a NASA-selected platform in the near future.

6.3 Implementation Activities

Proposal selection and award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO and Section 7 of this PEA with the following amendments.

6.3.1 Award Administration and Funding of Investigations

Oversight management responsibilities have been assigned to the Earth System Science Pathfinder Program Office (ESSP PO) at the NASA Langley Research Center. The responsibilities of the ESSP PO will include oversight of science instrument development; coordination of Government-furnished services, equipment and facilities, coordination of the selected team with potential platforms for integration; and contract management for selected investigations.

The ESSP PO will authorize the release of funding to each selected investigation. The initiation of the investigation's award of the contract will take place as soon as possible after notification of selection. In order for contracts to be awarded, Statements of Work (SOWs), updated cost and pricing data are required. For reference, a SOW template is available in the Program Library for the EVI-1 PEA. If more than one contractual arrangement between NASA and the proposing team is required, separate SOWs, updated cost, and pricing data are required for each contractual arrangement. NASA Centers will receive funding via intraagency funding mechanisms.

Proposals are not required to include SOWs and cost and pricing data. These will be required only for investigations that are selected for award. For those investigations that are selected, it will be in the best interest of the PI-led mission management teams to provide updated SOWs, cost and pricing data, and small business subcontracting plans in as timely a manner as possible. The process of awarding contracts cannot begin until final SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed. For each selection, and unless otherwise stated in the selection letter, the selected investigation's cost cap will be set at the proposal's proposed cost.

SOWs will be required for selected investigations, regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). For contracts that exceed \$700K, the contractor will be required to provide cost and pricing data to support the cost estimate and to certify the cost proposed for the contract in accordance with FAR 15.406-2.

NASA Centers shall follow their standard operation procedure for selecting teaming partners to facilitate the rapid implementation of their proposal, if selected, and this shall be documented in Appendix 6 of the proposal (see Appendix B, Section J.6, of the SALMON-2 AO).

6.3.2 *International Agreements*

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, NASA's Office of International and Interagency Relations, Science Division, will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency MOU.

7 SUMMARY OF KEY INFORMATION

Funding available	See Section 4.4.1 of this PEA
Release Date	February 7, 2012
Date for Preproposal Workshop	Mid-March 2012 in the Washington, DC, area; see the EVI-1 PEA additional information page at http://essp.larc.nasa.gov/EV-1/ for date, agenda, and logistical information
Due Date for NOI (notice of intent to propose)	11:59 p.m. Eastern Time on March 22, 2012
Due Date for Proposals	11:59 p.m. Eastern Time on May 8, 2012
Web site for additional information for the EVI-1 PEA	http://essp.larc.nasa.gov/EV-1/
Program Library for the EVI-1 PEA	http://essp.larc.nasa.gov/EV-1/evI_ProgramLibrary.html
Submission Medium	Electronic copies only; see Section 5.2 of this PEA
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)
NASA point of contact	Dr. Kenneth Jucks Earth Venture Instrument-1 Program Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-0476 E-mail: kenneth.w.jucks@nasa.gov

END OF PEA J

NNH12ZDA0060

SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)

NNH12ZDA0060-JUICE

**Program Element Appendix (PEA) K:
JUPITER ICY MOONS EXPLORER INSTRUMENT**

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SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)

NNH12ZDA0060-JUICE
PROGRAM ELEMENT APPENDIX (PEA) K:
JUPITER ICY MOONS EXPLORER INSTRUMENT

1 BACKGROUND

1.1 Programmatic Overview

Recently ESA selected the JUperiter ICy moons Explorer (JUICE) mission as the first mission in its Large-Class mission portfolio under the Cosmic Vision Program. The JUICE mission will investigate Jupiter and its icy moons, completing its mission by orbiting Ganymede. The mission is planned for launch in 2022. The NASA Science Mission Directorate (SMD) has offered to collaborate in this mission. The NASA contribution shall potentially consist of three types of contributions: 1) NASA-funded instrument investigations led by a U.S. Principal Investigator (PI), 2) NASA-funded instrument component(s) provided to non-U.S.-led instrument(s), and 3) NASA-funded U.S. Co-Investigators (Co-Is) on non-U.S.-led instrument(s). NASA's entire contribution consisting of the sum of all three types of contributions shall not exceed \$100M (RY) for total life cycle costs. Within this budget cap, NASA expects to fund approximately two U.S.-led instrument investigations along with a number of NASA-funded instrument components and U.S. Co-Is on non-U.S.-led instruments.

This Program Element Appendix (PEA) solicits proposals for the first type of contribution (NASA-funded instrument investigations led by a U.S. PI); parties interested in the latter two types of NASA contributions should respond to the ESA Announcement of Opportunity (AO) as members of a non-U.S.-led team.

NASA contributions will be managed through the NASA SMD Planetary Science Division (PSD) New Frontiers Program. The New Frontiers Program is designed to accomplish high-quality planetary science investigations using efficient management approaches. The Program's prime objective is to enhance our understanding of the solar system and of solar system formation and evolution. The New Frontiers Program objectives will produce the following outcomes:

- Advancement in scientific knowledge and exploration of the elements of our solar system and other planetary systems;
- Addition of scientific data, maps, returned samples, and other products to archives accessible to all scientists;
- Promulgation of scientific advancements and results in peer-reviewed literature, popular media, scholastic curricula, and other educational materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics;
- Expansion of the pool of well-qualified Principal Investigators (PI) and Program Managers for implementation of future missions in New Frontiers and other programs, through current involvement as Co-Investigators and other team members; and

- Implementation of technology advancements that have been proven in related programs.

It should be noted that this solicitation is being released in coordination with an ESA AO accessible on the ESA web page http://sci.esa.int/juice_ao. The ESA AO solicits instrument investigations for the provision of the scientific payload on board the JUICE spacecraft and is open to scientists from the Member States of ESA and other communities with which reciprocity or specific agreements exist (such as USA, Russia, Japan).

As part of that agreement, U.S. proposers wishing to provide NASA-funded instrument component(s) and/or U.S. Co-Investigators on non-U.S.-led instruments should respond to the ESA AO as part of a proposal team led by a non-U.S. PI. Proposals led by a U.S. PI requesting NASA funding must submit a proposal in response to this SALMON PEA solicitation. All proposed contributions requesting NASA funding will be evaluated by NASA. All proposed contributions transmitted from NASA to ESA will be considered within the ESA evaluation process for decision on the JUICE mission payload complement.

Proposals led by a U.S. PI not seeking NASA funding should respond to the ESA AO.

This solicitation calls for proposals from U.S. PIs for complete PI-led science investigations requiring spaceflight instrument development. The term “complete” encompasses investigation phases from project initiation, through instrument development and science operations, to scientific analysis of space based data. When deployed on the JUICE mission, these spaceflight instruments will be used to conduct innovative, integrated, hypothesis or scientific question-driven investigations addressing the science goals of the JUICE mission.

This solicitation solicits investigations addressing any of the JUICE science objectives presented in Section 2.2. Investigations must also address the broad science objectives in NASA’s Planetary Science program (see Section 2.1).

Investigations that address NASA goals in other areas such as heliophysics, astrophysics, or Earth science are not solicited in this solicitation. Priority will be given to cost-effective instruments with significant science return, manageable cost risk, and demonstrable development expertise and flight experience.

1.2 JUICE Mission Description

The JUICE mission is an ESA-led L-class mission of the ESA’s Cosmic Vision 2015-25 Programme. It aims at a comprehensive exploration of the Jovian system with particular emphasis on Jupiter, its environment, and Galilean moons Ganymede, Europa, and Callisto by investigating them as planetary bodies and potential habitats (JUICE science goals are provided in Section 2.2). The mission consists of a spacecraft that will be developed, procured, launched, and operated by ESA. The JUICE program will be managed by ESA. The JUICE baseline configuration consists of a 3-axis stabilized spacecraft powered by solar arrays. The planned launch date is June 2022, with a back-up opportunity in August 2023.

After 7.5 years of interplanetary transfer and Earth-Venus-Earth-Earth gravity assists, JUICE will be inserted into an orbit around Jupiter in January 2030. The spacecraft will stay for about a

year in an evolving elliptic orbit around Jupiter with a pericentre outside the Ganymede orbit. The orbit will allow detailed investigations of the inner magnetosphere of the giant planet, monitoring the Jupiter atmosphere and coupling processes. Six flybys of Ganymede will allow starting of the investigation of the moon.

The trajectory will mainly keep the spacecraft outside of the inner radiation belts at Jupiter with exception of two Europa flybys. These flybys will enable investigations of the composition, geology and subsurface of Europa. The spacecraft will use Callisto flybys to raise the inclination of the orbit around Jupiter to ~30 degrees and come back to the Jovian equatorial plane, which is necessary for the transfer to Ganymede. These orbits will allow observations of the polar regions of Jupiter. During the next 12 Callisto flybys, the mission will be focused on characterization of the internal structure, surface, and exosphere of that moon. The time between Callisto flybys will be devoted to continuous monitoring of Jupiter's atmosphere and magnetosphere, rings and environment, and remote observations of the other moons.

The following six months of transfer to Ganymede will again be favorable for the studies of the interaction of the Jovian magnetosphere with the intrinsic magnetic field of the moon, together with remote observation of the giant planet and the other icy moons. In September 2032, the spacecraft will be inserted in orbit around Ganymede. The JUICE orbital mission will consist of the following phases: elliptic/high circular orbits (10,000x200 km, ~5000 km circular), 1st low circular orbits at 500 km, and 2nd low circular orbits at 200 km. While going closer and closer to the moon, the spacecraft will address different scientific goals. In the first part of the Ganymede tour the imaging and spectro-imaging instruments will complete mapping of the surface using optimal illumination conditions. Then, the priority will be given to the geophysical, exospheric, and plasma investigations that require the spacecraft to be as close to the moon as possible. At the end of the mission there may be an opportunity to probe lower altitudes during the orbital decay that would allow sounding the Ganymede exosphere at different altitudes.

ESA has defined a model payload for the JUICE mission that consists of a notional set of instruments (Table 1, and described fully in the ESA Assessment Study Report and in the Model Payload Definition Document). The model payload, consisting of 11 instruments including radio science, has been used to quantify engineering aspects of the mission and spacecraft design, including analysis of operational scenarios required to obtain the data necessary to meet the science objectives. The model payload was influential in designing a reference spacecraft feasible for the JUICE mission.

Model Remote Sensing Package	Model Geophysical Package	Model <i>In Situ</i> Package
Visible and Infrared Hyper-spectral Imaging Spectrometer	Laser Altimeter	Magnetometer
Ultraviolet Imaging Spectrometer	Ice penetrating radar	Radio and Plasma Wave Instrument
Narrow Angle Camera	Radio Science Instrument and Ultrastable Oscillator	Particle Package
Wide Angle Camera		
Sub-millimeter Wave Instrument		

Table 1. JUICE model payload

Other instruments could possibly address the JUICE science goals and objectives. The model payload is not intended to preclude selection of alternative instrument types, or instruments with either broader or more focused capabilities. The model payload details presented in the ESA Assessment Study Report and in the Model Payload Definition Document are provided as informational only and are not intended to represent requirements or design approaches preferred by NASA. Proposers should note that while the model payload does not represent any pre-selection by either ESA or NASA of instruments or techniques to accomplish the mission science goals, the ESA review process intends to recommend a JUICE payload complement matching as closely as possible the objectives of the model payload.

The ESA Assessment Study Report and in the Model Payload Definition Document and Science Management Plan, and other documentation released with the ESA AO contain additional information on the JUICE mission and are linked to from the Program Library.

1.3 Overview of this Program Element Appendix

NASA issues this Program Element Appendix (PEA) as an appendix of the Second Stand Alone Missions of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO) for the purpose of soliciting proposals for Mission of Opportunity (MO) investigations to be managed under the NASA New Frontiers Program. All investigations proposed in response to this solicitation must support the goals and objectives of the JUICE mission and NASA's Planetary Science program (Section 2.1), must be implemented by Principal Investigator (PI) led investigation teams (Section 5.4 of the SALMON-2 AO), and must result in the provision of a flight qualified spaceflight instrument or instrument package ready for integration to the JUICE spacecraft (Phase A-C), technical support for integration onto the JUICE spacecraft (Phase D), and operation of the instrument and delivery of science quality data (Phase E), as described in Section 4.1 of the SALMON-2 AO.

Proposals submitted in response to this PEA will be evaluated and selected for NASA funding through a single step competitive process conducted by NASA. Proposals from U.S. PIs will be shared with ESA for concurrent evaluation by ESA panel(s) as described in the ESA Science Management Plan. ESA will share with NASA proposals submitted to the ESA AO containing NASA-funded contributions, and NASA shall evaluate these contributions accordingly. As the outcome of the single step NASA review of all three types on contributions requesting NASA funding, NASA intends to select for funding approximately two proposed U.S.-led instrument investigations in addition to a number of proposals led by non-U.S. PIs submitted to the ESA AO and containing U.S. Co-Is and/or U.S.-provided components. The total value of these selected NASA contributions must not exceed \$100M (RY) for the total life cycle cost. These selections will represent the NASA contributions to the ESA JUICE mission. Upon completion of the ESA AO process for JUICE instrument selection and eventual positive decision from ESA, these investigations will proceed to development for flight and operations. NASA contributions must comply with technical requirements and schedule provided by ESA and managed by the New Frontiers Program Office. If multiple proposals are deemed selectable such that combined costs are within the available funding (as defined in Section 4.4.1), NASA may select additional U.S.-led instrument investigations in response to this solicitation. Additional information on proposal evaluation, selection, and implementation is available in Section 6.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO contains additional requirements on the format and content of the proposals. Documents, available through the JUICE Program Library at <http://soma.larc.nasa.gov/juice/programlibrary> are intended to provide guidance for investigations selected; they are specifically not intended to impose requirements on proposals.

1.4 NASA On-line Document Information System

NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents are available through the NASA On-line Document Information System (NODIS) at <http://nodis3.gsfc.nasa.gov/>.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 NASA Planetary Science Goals

NASA's overarching goal in Planetary Science is to "ascertain the content, origin, and evolution of the solar system, and the potential for life elsewhere." NASA pursues this strategic goal by seeking answers to fundamental science questions that guide NASA's solar system exploration:

- What is the inventory of solar system objects and what processes are active in and among them?
- How did the Sun's family of planets, satellites, and minor bodies originate and evolve?
- What are the characteristics of the solar system that lead to habitable environments?
- How and where could life begin and evolve in the solar system?
- What are the characteristics of small bodies and planetary environments that pose hazards and/or provide resources?

To answer these questions, the following research objectives are addressed:

- Inventory solar system objects and identify the processes active in and among them.
- Understand how the Sun's family of planets, satellites, and minor bodies originated and evolved.
- Understand the processes that determine the history and future of habitability of environments on Mars and other solar system bodies.
- Understand the origin and evolution of Earth life and the biosphere to determine if there is or ever has been life elsewhere in the universe.
- Identify and characterize small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources.

Further information on NASA's strategic goals in Planetary science may be found in the *2010 NASA Science Plan for NASA's Science Mission Directorate*, and information on NASA's strategic goals may be found in the most recent version of the *NASA Strategic Plan*. Both are available through the Program Library.

2.2 JUICE Science Goals and Objectives

JUICE is aimed at a thorough investigation of the Jupiter system in all its complexity with emphasis on Galilean satellites, and in particular the potential habitability of the two icy moons, Ganymede and Europa. The overarching theme for JUICE is *the emergence of habitable worlds around gas giants*. The mission would address the question “*Are there current habitats elsewhere in the Solar System with the necessary conditions (organic matter, water, energy, stability and nutrients) to sustain life?*”

The focus of JUICE is to characterize the conditions that may have led to the emergence of habitable environments among the Jovian icy satellites, with special emphasis on the three ocean-bearing worlds: Ganymede, Europa, and Callisto. Ganymede is identified for detailed investigation since it provides a natural laboratory for analysis of the nature, evolution, and potential habitability of icy worlds in general, but also because of the role it plays within the system of Galilean satellites, and its unique magnetic and plasma interactions with the surrounding Jovian environment. JUICE will determine the characteristics of liquid-water oceans below the icy surfaces of the moons. This will lead to a better understanding of the possible sources and cycling of chemical and thermal energy, allow investigation of the evolution and chemical composition of the surfaces and of the subsurface oceans, and enable an evaluation of the processes that have affected the satellites and their environments through time. The study of the diversity of the satellite system will be enhanced with additional information gathered remotely on Io and smaller moons. The mission will also focus on characterizing the diversity of processes in the Jupiter system which may be required in order to provide a stable environment at Ganymede, Europa, and Callisto on geologic time scales, including gravitational coupling between the Galilean satellites and their long term tidal influence on the system as a whole. Focused studies of Jupiter’s atmosphere (its structure, dynamics, and composition) and magnetosphere (three-dimensional properties of the magnetodisc and coupling processes) and their interaction with the Galilean satellites will further enhance our understanding of the evolution and dynamics of the Jovian system that is considered as a mini-Solar System in its own right.

In conclusion, by performing detailed investigations of Jupiter’s system in all its complexity, JUICE will address in depth two key questions of ESA’s Cosmic Vision program:

1. What are the conditions for planet formation and the emergence of life?
2. How does the Solar System work?

The mission will investigate the Jovian atmosphere and magnetosphere; study Europa during two flybys and Callisto in 12 flybys; and provide a detailed survey of Ganymede, its atmosphere, and plasma environment from orbit. Specific science objectives of the JUICE mission are as follows:

1. Study Ganymede as a planetary object including its potential habitability
 - a. characterize the ice shell, extent of the ocean, and its relation to the deeper interior;
 - b. determine global composition, distribution, and evolution of surface materials;
 - c. understand the formation of surface features and search for past and present activity;

- d. characterize the local environment and its interaction with the Jovian magnetosphere.
2. Explore Europa's recently active zones
 - a. determine the composition of the nonice material, especially as related to habitability;
 - b. look for liquid water under the most active sites;
 - c. study the recently active processes.
3. Study Callisto as a remnant of the early Jovian System
 - a. characterize the outer shells, including the ocean;
 - b. determine the composition of the nonice material;
 - c. study the past activity.
4. Explore the Jupiter System as an archetype for gas giants
 - a. characterize the atmospheric dynamics and circulation, composition and chemistry, and vertical structure;
 - b. characterize the magnetosphere as a fast magnetic rotator and giant accelerator;
 - c. understand the moons as sources and sinks of magnetospheric plasma;
 - d. study Io's activity and surface composition;
 - e. study the main characteristics of rings and small satellites.

A detailed description of the science objectives of the JUICE mission is reported in the Science Requirement Document, part of the ESA AO documentation.

2.3 Accommodation of JUICE Instruments

The objective of this solicitation is to select for funding investigation(s) where an instrument(s) is built and deployed on the JUICE spacecraft followed by production of high quality and highly useful science data from that instrument. Selection of proposals from this solicitation will balance the "accommodability" of the proposed instruments with the value of the science to be returned from the selected investigations.

The instruments provided through this PEA will have to work within the available resources. Hence, there will be some constraints on the specifications of any instruments potentially selected for development through this PEA. Proposed instruments that cannot meet the constraints of the JUICE mission (as documented in the ESA AO documentation and ESA Science Management Plan) will be seen as higher risk for accommodation than those that have greater specification margin.

2.4 NASA Management of the JUICE contributions

The selected investigation(s) will be managed by the New Frontiers Program. The Associate Administrator for SMD has established a New Frontiers Program Office at the NASA Marshall Space Flight Center (MSFC) to be responsible for project oversight. The New Frontiers Program Manager at NASA MSFC reports to the New Frontiers Program Director at NASA Headquarters. Additional details about the program office staffing, structure, and goals can be found in the New Frontiers Program Plan, available through the Program Library. There are appropriate protective firewalls between the New Frontiers Program Office and the rest of MSFC, allowing investigators from MSFC to propose in response to this PEA. The New Frontiers Program Office

will manage the JUICE investigations under the requirements of NPR 7120.5D NID, *NASA Space Flight Program and Project Management Requirements*, as described in Section 4.1.2 of the SALMON-2 AO.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

This solicitation is an appendix to the NASA Second Stand Alone Mission of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO). The SALMON-2 AO provides the overall structure and guidelines for several types of mission of opportunity solicitations. Each new opportunity is announced with a Program Element Appendix (PEA). This document is such a PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com> and at <http://go.nasa.gov/SALMON2-AO>.

This PEA solicits science investigations funded by NASA that include the development of instruments to be provided to and integrated with the ESA JUICE mission spacecraft.

Evaluation and selection for funding will be done using a single step selection process; no competitive Phase A (Step 2) or down selection is planned. Normal instrument Phase A activities will be conducted by the selected investigation team or teams following selection.

The following schedule applies to this PEA.

- A Preproposal Meeting will take place in association with this solicitation and will be coordinated with ESA. Further information will be available at the JUICE Acquisition website (<http://soma.larc.nasa.gov/juice/>) prior to the Preproposal Meeting.
- Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA. The period for questions will close two weeks before the proposal due date.
- A Notice of Intent (NOI) to propose to this announcement is extremely valuable to NASA **and ESA** for purposes of planning the proposal evaluation and peer reviews, and, therefore, is **encouraged required**. NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. **Proposals will not be accepted without prior submission of an NOI by the deadline given in Section 7 of this PEA.** Section 6.1.2 of the SALMON-2 AO provides information on electronic NOI submission through NSPIRES. [**amended 7/13/12**]
- All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.
- NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four months following receipt of the Statement of Work, as set forth in Section 6.3.1 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Propose

Refer to Section 4.2 of the SALMON-2 AO for the rules on participation policy. For this particular PEA, NASA will place full or partial limitations (as described in the SALMON-2 AO) on organizations that will be involved in the evaluation process. Cornell Technical Services LLC (CTS) is subject to the “Full Limitation” as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on the Aerospace Corporation for this JUICE PEA.

4.2 Type of Mission of Opportunity

In the context of the SALMON-2 AO, this Program Element Appendix is a Focused Mission of Opportunity (FMO). A FMO is one that addresses a specific, NASA-identified flight opportunity that fulfills the solicited objectives and includes all of the elements specified in this document and in Appendix B of the SALMON-2 AO. The ESA JUICE mission is the flight opportunity identified for this FMO.

The investigation PI is responsible for conducting the proposed science investigation which includes, but is not limited to: (i) development and delivery of the instrument or instrument package; (ii) working with ESA and NASA to integrate the instrument on the chosen platform; (iii) commissioning, validating, and operating the instrument and ground systems on-orbit in order to carry out the proposed science investigation; (iv) preparing and delivering appropriate data analysis software, including required calibration data, analyzing the data, archiving the data in a NASA chosen Distributed Active Archive Center (DAAC) as described in Section 4.5.4, and reporting the results of the science investigation in the science literature.

4.3 Science Requirements and Constraints

The science objectives were described in Section 2, and additional information can be found in the ESA Assessment Study Report and ESA AO documentation package (e.g., Science Requirements Document). Any appropriate science question relevant to Planetary science and the JUICE science objectives can be addressed with the proposed investigations. Section 2 provides the basis for the evaluation of intrinsic science merit as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside Planetary science and/or the stated JUICE science objectives as described in Section 2 are not solicited through this call.

Requirement K-1. Proposals shall address appropriate science questions relevant to Planetary science and the JUICE science objectives as described in Section 2 of this PEA.

Requirement K-2. Each proposal shall clearly define its science question or questions, shall demonstrate how the science questions map into high-level science requirements, and shall show how the science requirements subsequently map into the measurement requirements.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement K-3. Each proposal shall clearly state the baseline and threshold requirements for the performance of the instrument and the prime lifetime for operation of the instrument.

A Co-Investigator (Co-I) is defined as an investigator who plays a necessary role in the proposed investigation and whose services are either funded by NASA or are contributed by his/her employer. Every Co-I must have a role that is required for the successful development of the instrument science investigation, and the necessity of that role must be justified. The identification of any unjustified Co-Is will result in the downgrading of an investigation and/or the offer of only a partial selection by NASA. NASA plans to provide an opportunity to add additional team members to assist with science operations prior to arrival at Jupiter.

Requirement K-4. Proposals shall designate all Co-Is, describe the role of each Co-I in the development of the instrument investigation, and justify the necessary nature of the development role.

NASA expects each proposal to fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the selected PI led investigation, the proposals should provide information about the commitment to funding for those data in the time line of 5-10 years after selection of the investigation and describe the implications to meeting the science requirements if such data do not exist.

Requirement K-5. Each proposal shall fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the selected PI led investigation, the proposals should provide information about the expectations for available calibration and validation instruments and/or data in the time line of 5-10 years after selection of the investigation and describe the implications to meeting the science requirements if such activities do not exist.

4.4 Cost and Schedule Requirements and Constraints

4.4.1 Cost Requirements and Constraints

NASA's total contribution to the ESA JUICE mission shall not exceed \$100M RY for the sum of all three types of contributions (U.S.-led instrument investigations, components provided to non-U.S.-led instruments, and U.S. Co-Is on non-U.S.-led instruments). For U.S.-led instrument investigations, the PI-Managed Investigation Cost shall be used when determining the value of the contribution.

Assuming the submission of an adequate number of proposals of merit, NASA expects to select a programmatically balanced mixture of the three types of U.S. contributions described above, including approximately two U.S.-led instrument investigations that address the JUICE science objectives. NASA may select more or less than two proposed instrument investigations depending on proposal merit and the proposed cost of NASA contributions.

Each selected investigation is PI-Managed, and the PI will be responsible for defining and controlling the costs within the proposed budget for each phase of the investigation. Because

ESA will be providing the spacecraft to be used by the selected investigation, some costs cannot be defined and controlled by the PI, and these costs will be outside the constrained PI-Managed Investigation Cost. This section identifies those costs which are constrained within the PI-Managed Investigation Cost and those where NASA requires planning budgets that are outside the constrained PI-Managed Investigation Cost. A summary of budgeted costs that are and are not to be included in the PI-Managed cost cap is listed in Table 2.

Contributions from sources other than NASA, whether U.S. or non-U.S., are welcome. These may include, but are not limited to, labor, services, and/or contributions to the instrument investigation, subject to the following exceptions and limitations: (i) contributions of non-U.S. nuclear power or thermal sources are prohibited; and (ii) in order to ensure a preponderance of NASA interest in the instrument investigation, as well as to ensure that instrument investigations of roughly comparable scope are proposed for purposes of equitable competition, the sum of contributions of any kind to the entirety of the investigation is not to exceed one-third (1/3) of the proposed PI-Managed Investigation Cost. Such contributions will not be counted against the PI-Managed Investigation Cost, but they must be included in the calculation and discussion of the Total Investigation Cost.

Costs that are within the PI-Managed Investigation Cost include: instrument delivery ready for integration onto the selected platform (Phases A-C); integration to the ESA provided platform (Phase D); development and delivery of functional algorithms and ground processing system (Phases B-D); supporting the proposed science team that will contribute directly to the successful implementation of the investigation (Phases A-F); required calibration and validation activities (Phases C-E); operations, product generation, and data analysis and archiving during the proposed prime lifetime of the investigation (Phases E); and close out of the investigation once the investigation has been concluded (Phase F).

Costs that are outside the PI-Managed Investigation Cost include access to space, which is provided by ESA and contributions from sources other than NASA, including both U.S. and non-U.S. sources (not to exceed one-third of the proposed PI-Managed Investigation Cost).

Portion of the Investigation	Within PI-Managed Costs	Outside PI-Managed Costs
Phase A/B/C/D/E/F	X	
Cost for access to space		X
Non-NASA Contributions		X
Core E/PO program	X	
Student Collaboration (SC) (optional)	X	

Table 2: List of which portions of the investigation are within and outside the PI-Managed Investigation Cost. Budgets for both, excluding the cost for access to space, are required in each proposal.

The New Frontiers Program's planning budget can accommodate selections totaling cost cap for all NASA contributions up to \$100M RY with a typical funding profile over the development schedule described in the ESA Science Management Plan. Proposers should propose a funding profile that is appropriate for their investigation. Cost proposals whose requested funding profile

significantly differs from the New Frontiers Program's planning budget for JUICE may be difficult to accommodate, and NASA cannot guarantee that the proposed funding profile can be accommodated within the New Frontiers Program's budget. **The inability of NASA to accommodate the requested funding profile may be a reason for nonselection of a proposal.** A final funding profile for the selected instrument investigations will be negotiated between the New Frontiers Program and the selected investigation team.

Requirement K-6. Proposals shall be for complete investigations including Phases A-F.

Requirement K-7. Proposals shall include detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Investigation Cost (see Table 2).

Requirement K-8. Proposals shall include integration plans and planning budgets that occur during Phase D and that align with the schedule provided by ESA in the Science Management Plan.

4.4.2 Schedule Requirements and Constraints

Each selected investigation under the JUICE solicitation will be expected to deliver an instrument that can be integrated onto the ESA provided spacecraft according to the schedule provided by ESA. Nominally, this will span the years of FY 2013-FY 2018, with instrument delivery to the spacecraft for integration currently scheduled for November 2018. This is expected to cover development Phases A through C. Proposals that include a more rapid instrument development timeline may be selected, provided the required budget phasing can be accommodated by NASA.

Requirement K-9. Proposals shall include a detailed development schedule (including integration plans) and an associated planning budget that aligns with the schedule provided by ESA in the Science Management Plan.

4.5 Technical Requirements and Constraints

4.5.1 Science Instrument System

Complete details on the technical requirements and constraints on the payload can be found in the ESA AO documentation and Science Management Plan. Additional information is also available in the Assessment Study Report. All of these documents are linked through the Program Library.

Instrument characteristics must be well characterized and clearly stated within the proposal in order for NASA and ESA to determine the feasibility of accommodating the instrument on the JUICE spacecraft.

Requirement K-10. Proposals shall clearly state the proposed instrument mass, volume dimensions, power requirements, platform stabilization requirements, thermal requirements, observational geometry requirements, launch vibration constraints, electromagnetic interference/electromagnetic compatibility (EMI/EMC) requirements, data rate requirements, and all other requirements (or constraints, preferences, etc.) that

the instrument places on the platform for accommodation, launch, deployment, operations, etc.

Requirement K-11. Proposals shall clearly state the ability of the instrument to operate in the orbits and environments expected for the JUICE spacecraft and provide operational constraints (e.g., duty cycle or observational cadence) on the instrument.

The selected instruments must meet the applicable planetary protection requirements as documented in the JUICE/Laplace Planetary Protection Categorization and ESA Planetary protection requirements documents linked from the Program Library.

4.5.2 Payload Risk Classification

This opportunity solicits proposals for science investigations requiring the development and operation of space-based instruments, designated as Class B (high priority, low risk as defined in NPR 8705.4, *Risk Classification for NASA Payloads*) on a platform to be provided by ESA.

4.5.3 End-of Mission Spacecraft Disposal

Section 5.3.10 of the SALMON-2 AO discusses the requirements related to end-of-mission spacecraft disposal for Partner Missions of Opportunity and hosted payloads where the PI is not responsible for the host mission. For these proposals, information shall be included regarding the instrument's plan for passivation at the end of operations or in preparation for end-of-mission disposal.

Requirement K-12. Proposals shall describe the instrument's passivation plans at end-of-mission and identify instrument components anticipated to survive Earth reentry. This supersedes Requirement 39 in the SALMON-2 AO.

4.5.4 Science Data Policy

For planning purposes for proposals, proposers responding to this PEA should abide by the science data policy described below, including the requirement to archive data in both the NASA Planetary Data System (PDS) and the ESA science data archive. Selected instrument investigations will be expected to abide by the science data policies eventually finalized by the JUICE Science Working Team, NASA, and ESA and documented in the Science Management Plan and Memorandum of Understanding (MOU) established between NASA and ESA after selection.

4.5.4.1 Data Analysis

The PI on U.S.-led instrument investigations will be responsible for analysis of the investigation data necessary to complete the proposed science objectives, for archiving the data in the NASA PDS and the ESA science data archive for public use, and for timely publication of initial scientific results in refereed scientific journals, as part of their mission operations (Phase E) or postmission (Phase F) activities. Proposals must allocate sufficient resources for this data analysis and archiving. Any science studies with the archived data sets beyond the PI-led teams proposed science investigation will be solicited and selected by NASA in subsequent NASA

solicitations through the Research Opportunities in Space and Earth Sciences (ROSES) NASA Research Announcement.

Instrument investigations are required to share data with the JUICE Science Working Team (SWT) members so as to enhance the scientific return from the mission in accordance with the procedures to be agreed and formalized within the SWT.

Requirement K-13. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final on-orbit calibration and validation of the measurements. In accordance with the SMD requirement for open data and related software, any specialized software and algorithms required for basic data analysis and processing will be made available by the PI to the science community and public.

Requirement K-14. Proposals shall clearly present a plan for analysis of the investigation data leading to completion of the proposed science investigation and achieving the identified investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.5.4.2 Data Rights

By NASA policy, all science data returned from NASA investigations led by a NASA-funded PI are made available immediately in the public domain. Following a postflight checkout period, all data will be made available to the user community. There shall be no period of exclusive access. The principal investigator will propose the data product latency period for standard products listed in the proposal, and a justification for it must be demonstrated. Barring exceptional circumstances, data product latency may not exceed six months.

Requirement K-15. Proposals shall include a clear commitment to minimizing the latency for data products. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.5.4.3 Delivery of Data to Archive

Investigation data will be made fully available to the public by the investigator team through the PDS and the ESA science data archive in usable form, in the minimum time necessary and, in any case, within six months following its collection. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to making it fully available. By the investigation closeout, the investigation will deliver to the PDS and the ESA science data archive all final data products, along with the scientific algorithm software, coefficients, ancillary data used to generate these products, and the algorithm and calibration documentation.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in-flight), documentation, related software, and/or other tools or parameters that are necessary to interpret

the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large and provided within six months of data receipt from the spacecraft.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed investigation data archiving plans and budgets must be consistent with the policies and practices of the PDS and the ESA science data archive. For the PDS, guides to the archiving process and tools for data archive preparation may be downloaded from the PDS website (<http://pds.nasa.gov/tools/index.shtml>). Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the capped PI-Managed Investigation Cost.

Requirement K-16. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving shall be described. The science products (*e.g.*, flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the formats and standards to be used, selected from the published list of approved PDS Standards. It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community.

4.6 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are specified in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.4.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirement and constraints for that specific solicitation, including the sponsoring NASA Headquarters (HQ) mission directorate and division, the type of MO, the cost cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2, the cost cap is specified in Section 4.4.1, and the schedule constraint is specified in Section 4.4.2.
- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. The NASA Center for program office is specified in Section 2.4. There is no program-specific safety, reliability, and quality assurance document.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the payload risk classification is specified in Section 4.5.2.

- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation by Aerospace in proposals. There are no additional restrictions on participation by Aerospace in proposals.
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Investigation Cost, the Total Investigation Cost, and the Enhanced Investigation Cost. For this PEA, that information is specified in Section 4.4.1.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.4.1 and 4.4.2.
- Section 4.6 of the SALMON-2 AO states that each PEA will identify any NASA-provided launch services. For this PEA, NASA plans for access to space are discussed in Section 4.2.
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Section 3 a two-step competitive process is not being used.
- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an E/PO program that is consistent with SMD policy is required. This PEA so states, and Requirements 68, 69, and 70 of the SALMON-2 AO apply to this PEA.
- Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA
- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by SMD and it does not permit contributions of funding from SMD programs other than the funding offered through this PEA.
- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection official. This PEA identifies the Selection official in Section 6.2.

4.7 Exceptions to General SALMON-2 Requirements

This PEA contains the following exceptions to the SALMON-2 proposal preparation and submission requirements described in the SALMON-2 AO.

- Section 4.5.4 of this PEA provides data policies and supersedes Section 4.4 of the SALMON-2 AO.
- Proposals shall not include a plan or a budget for science-exploration-technology enhancement options (SEOs); this supersedes Section 5.2.5 of the SALMON-2 AO.
- Section 4.5.3 provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO.
- Section 4.3 Requirement K-4 defines a Co-I as having a role in the development of the investigation and this supersedes the definition in Section 5.6.2 of the SALMON-2 AO.
- NASA will provide all proposals submitted in response to this PEA to ESA. The proposals will undergo the ESA review process concurrent with the standard NASA review described

in Section 6 of this PEA. The ESA evaluation process is described in the ESA JUICE Science Management Plan.

- Requirement K-17 allows an extra 5 pages (40 pages total) for the Science Investigation Experiment Implementation, Investigation Implementation Schedule Foldout, and Management sections (Sections D, E, F, and G).
- **Section 3 of this PEA requires submission of a NOI by the deadline given in Section 7. Proposals will not be accepted to this solicitation without prior submission of a NOI by that deadline. This supercedes Section 6.1.2 of the SALMON-2 AO that states that submission of a NOI is not required for the submission of a proposal. [amended 7/13/12]**

5 PROPOSAL PREPARATION AND SUBMISSION

5.1 Proposal Content Requirements

Requirement K-17. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO, except that proposals are allowed a total of 40 pages for the Science Investigation Experiment Implementation, Investigation Implementation Schedule Foldout, and Management sections (Sections D, E, F, and G).

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA reviewers.

The key data associated with the electronic submission of proposals (see Section 6.2 of the SALMON-2 AO) includes questions indicating whether or not a proposal contains export controlled information (see Sections 5.9.4 and 5.10.2 of the SALMON-2 AO). All proposers must answer these questions YES or NO when completing the electronic submission; these questions shall not be left unanswered.

All proposals must identify any export controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO. To the extent possible, ITAR sensitive material should be organized into separate clearly marked sections.

Requirement K-18. All proposals must identify any export controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO.

ESA requires the submission of an Experiment Interface Document - Part B (EID-B) to facilitate its evaluation and expedite preparations for review milestones after selection. The EID-B documents the instrument specific interface between the proposed instrument and the spacecraft. As stated in the ESA AO, the purpose of the EID-B is to formalize the proposer's response to the technical and programmatic requirements. After selection, the EID-B will be maintained and updated at regular intervals. This document shall be arranged according to the template provided in the Program Library.

The EID-B will not be used as part of the NASA evaluation and selection process. Upon submission NASA will immediately forward the EID-B to ESA without technical review. [amended 9/5/12]

Requirement K-19. All proposers must provide an Experiment Interface Document-Part B (EID-B) as a standalone appendix separate from the proposal. The EID-B shall be arranged according to the template provided in the Program Library. [amended 9/5/12]

5.2 Proposal Submission Requirements

Requirement K-20. Proposals must be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only; however, for this PEA, NASA does plan to share proposals with ESA for its review.

Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement K-21. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

Requirement K-22. The EID-B must be received no later than 11:59 p.m. Eastern Time on October 8, 2012. The EID-B must be submitted electronically as a single PDF file via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/>. [amended 9/5/12]

5.3 Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this appendix, or in the documents available through the JUICE Program Library, should be sent to the e-mail address for questions listed in Section 7 of this PEA. When appropriate, responses will be posted on the website listed in Section 7 of this PEA.

The deadline for receipt of questions is two weeks before the proposal due date listed in Section 7 of this PEA.

6 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

After the evaluation, but prior to the selection decision, NASA will perform an accommodation study of selectable proposals to assess the extent to which the proposed instrument is compatible with the JUICE spacecraft and other potential payload components. ESA will also perform its own parallel accommodation study as described in the ESA AO and Science Management Plan.

ESA has opened the provision of the scientific payload to scientists from the Member States of ESA and other communities with which reciprocity or specific agreements exist. NASA expects that proposals led by non-U.S. PIs will be submitted in response to the ESA AO while proposals led by a U.S. PI must be submitted in response to this PEA. **Any Information about** proposals submitted to ESA with a U.S. contribution requesting NASA funding (either for personnel, instrument components, or any combination thereof) will be provided to NASA by ESA **at any level to the extent required by NASA for their evaluation of such proposals after redaction of financial information from ESA member state(s)**. NASA will review only the NASA contribution of those proposals. ESA will **share relevant information with provide to NASA the regarding its** review of those full proposals from its evaluation panel(s), and NASA will consider the ESA evaluation results as part of its selection process. **[amended 7/13/12]**

In addition to the standard NASA evaluation process (as described in Section 7 of the SALMON-2 AO), proposals submitted to NASA by U.S. PIs will be provided to ESA and undergo the ESA evaluation process described in the ESA Science Management Plan. NASA will share the results of the NASA evaluation process with ESA for consideration by its evaluation panel(s), which is tasked with recommending to ESA an optimal instrument complement.

The review panel evaluating the third evaluation criterion; technical, management, and cost (TMC) feasibility of the proposed investigation, including cost risk, will also provide comments to NASA regarding the extent to which the proposed instrument is compatible with the JUICE spacecraft interfaces and operations. These comments will not contribute to the TMC feasibility risk rating but will be considered by the selection official.

6.2 Selection Process

After the review by the AO Steering Committee, the final evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the final selection(s). As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency concerning the selections.

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among top-rated proposals, including, but not limited to, planning and policy considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the mission directorate(s). For this JUICE PEA selection, these factors also include the likelihood that the proposed instrument can be accommodated on the JUICE spacecraft.

The selection of investigations by NASA will be coordinated with ESA prior to its final selection of the JUICE payload.

6.3 Implementation Activities

Proposal selection and award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO and Section 7 of this PEA with the following amendments.

6.3.1 Award Administration and Funding of Investigations

Oversight management responsibilities have been assigned to the New Frontiers Program Office at the Marshall Space Flight Center. The responsibilities of the New Frontiers Program Office will include oversight of science instrument development; coordination of Government-furnished services, equipment and facilities; coordination of the selected team with the JUICE spacecraft and mission team for integration; and contract management for selected investigations.

The New Frontiers Program Office will authorize the release of funding to each selected investigation. The initiation of the investigation's award of the contract will take place as soon as possible after notification of selection. In order for contracts to be awarded, Statements of Work (SOWs), updated cost and pricing data are required. For reference, a SOW template is available in the Program Library for the JUICE PEA. If more than one contractual arrangement between NASA and the proposing team is required, separate SOWs, updated cost, and pricing data are required for each contractual arrangement. NASA Centers will receive funding via intraagency funding mechanisms.

Proposals are not required to include SOWs and cost and pricing data. These will be required only for investigations that are selected for award. For those investigations that are selected, it will be in the best interest of the PI-led investigation management teams to provide SOWs, cost and pricing data, and small business subcontracting plans in as timely a manner as possible. The process of awarding contracts cannot begin until final SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed. For each selection, and unless otherwise stated in the selection letter, the selected investigation's cost cap will be set at the proposal's proposed cost.

SOWs will be required for selected investigations, regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). For contracts that exceed \$700K, the contractor will be required to provide cost and pricing data to support the cost estimate and to certify the cost proposed for the contract in accordance with FAR 15.406-2.

NASA Centers shall follow their standard operation procedure for selecting teaming partners to facilitate the rapid implementation of their proposal, if selected, and this shall be documented in Appendix 6 of the proposal (see Appendix B, Section J.6, of the SALMON-2 AO).

6.3.2 International Agreements

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, the Science Division of NASA's Office of International and Interagency Relations will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-

exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency MOU.

7 SUMMARY OF KEY INFORMATION

Funding available	See Section 4.4.1 of this PEA
FBO Announcement	June 13, 2012
PEA Release Date	July 6, 2012
Date for Preproposal Workshop	July TBD, 2012, in the Washington, DC, area; see the JUICE PEA additional information page at http://soma.larc.nasa.gov/juice/ for date, agenda, and logistical information. In coordination with ESA Briefing meeting.
Due Date for required NOI (notice of intent to propose) [amended 7/13/12]	11:59 p.m. Eastern Time on July 27, 2012
Due Date for Proposals	11:59 p.m. Eastern Time on September 24, 2012
Web site for additional information for the JUICE PEA	http://soma.larc.nasa.gov/juice/
Program Library for the JUICE PEA	http://soma.larc.nasa.gov/juice/programlibrary
ESA AO website	http://sci.esa.int/juice_ao
Submission Medium	Electronic copies only; see Section 5.2 of this PEA
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)
NASA point of contact	Dr. Curt Niebur JUICE Program Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-0390 E-mail: curt.niebur@nasa.gov

END OF PEA K

NNH12ZDA0060

SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)

NNH12ZDA0060-APEXMO

Program Element Appendix (PEA) L:

ASTROPHYSICS EXPLORER MISSION OF OPPORTUNITY

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NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)

NNH12ZDA0060-APEXMO
PROGRAM ELEMENT APPENDIX (PEA) L:
ASTROPHYSICS EXPLORER MISSION OF OPPORTUNITY

1 BACKGROUND

1.1 Programmatic Overview

The National Aeronautics and Space Administration (NASA) issues this Second Stand Alone Missions of Opportunity Notice (SALMON-2) Program Element Appendix (PEA) for the purpose of soliciting proposals for Astrophysics Mission of Opportunity (MO) science investigations to be implemented through its Explorer Program.

Three Mission of Opportunity types may be proposed in response to this PEA: Partner Missions of Opportunity (PMOs), New Missions using Existing Spacecraft (NMESs), and Small Complete Missions (SCMs), including investigations requiring flight on high-altitude scientific balloon platforms, investigations on the International Space Station (ISS), investigations launched as secondary payloads, or investigations launched as hosted payloads. A fourth type of investigation, U.S. Participating Investigators (USPIs), may be proposed in response to Appendix D.11, Astrophysics Explorer U.S. Participating Investigators, of the NASA Research Announcement, Research Opportunities in Space and Earth Sciences 2012 (ROSES-12), which is being released simultaneously with this PEA.

Investigations may target any astrophysics scientific investigation that advances the objectives outlined in Section 2.1 of this PEA. Investigations that address NASA goals in other areas, such as heliophysics, Earth science, or planetary science, are not solicited.

1.2 Explorer Program Background

The Explorer Program is the oldest continuous program in NASA. It is comprised of a longstanding series of space science missions that are independent, but share a common funding and NASA oversight/insight management structure. Initiated with the Explorer 1 launch in 1958 and including the Nobel Prize yielding Cosmic Background Explorer (COBE) mission, the Explorer program has launched over 90 missions.

Though historically not always this way, the program currently administers only Principal Investigator (PI)-led science investigations for the Heliophysics and Astrophysics Divisions of NASA's Science Mission Directorate (SMD). Competitive selection ensures that the most current and best science that can be done within the cost cap will be accomplished.

Since the early 1990s, the Explorer Program has provided several classes of flight opportunities for addressing astrophysics and heliophysics science objectives. These mission classes are defined by their cost caps and are designed to increase the number of flight opportunities in response to recommendations from the scientific community. The Explorer Program currently

consists of stand-alone “full missions,” for which NASA provides a dedicated launch vehicle, and smaller investigations called “missions of opportunity.”

Explorer Missions of Opportunity are investigations generally characterized by being part of a host space mission other than a strategic SMD mission, by being small complete missions with access to space, or by being new science investigations utilizing existing spacecraft. For each Explorer AO, the budget available for a full mission or MO varies, as do the types of investigations that may be proposed.

Explorer Program MOs are solicited through the SALMON-2 AO (NNH12ZDA006O) by amending it with a specific Program Element Appendix. This solicitation for Astrophysics Explorer Missions of Opportunity is one such PEA.

1.3 Overview of this Program Element Appendix

The SALMON-2 AO provides the overall structure and guidelines for several types of mission of opportunity solicitations. Each new opportunity is announced with a PEA. This document is one such PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/> or at <http://go.nasa.gov/SALMON2-AO>.

NASA issues this PEA as an appendix of the SALMON-2 AO for the purpose of soliciting proposals for Astrophysics Explorer MO investigations to be managed under the NASA Explorer Program. All investigations proposed in response to this solicitation must support NASA’s astrophysics science goals (Section 2.1 of this PEA) and the goals and objectives of the Explorer Program (Section 2.2 of this PEA), must be implemented by Principal Investigator (PI)-led investigation teams (Sections 4.2.4 and 5.4.1 of the SALMON-2 AO), and must result in the provision of complete space investigations (Section 5.3.2 of the SALMON-2 AO).

Proposals submitted in response to this PEA will be evaluated and selected through a single step competitive process. As the outcome of this single step, NASA intends to select nominally one proposed investigation to proceed to mission development for flight and operations. If numerous proposals are deemed selectable such that combined costs are within the available funding (as defined in Section 4.4.1 of this PEA), NASA may select more than one investigation in response to this solicitation.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO contains additional requirements on the format and content of the proposals. Documents, available through the Astrophysics Explorer Program Library (hereafter referred to as the Program Library) at <http://soma.larc.nasa.gov/astrophysics/programlibrary.html> are intended to provide guidance for investigations selected; they are specifically not intended to impose requirements on proposals.

1.4 NASA Online Document Information System

NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents are available through the NASA On-line Document Information System (NODIS) at <http://nodis3.gsfc.nasa.gov/>.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 NASA Astrophysics Science Goals and Objectives

NASA's strategic goals in astrophysics are to "Discover how the universe works, explore how the universe began and developed into its present form, and search for life elsewhere." Further information on NASA's strategic goals may be found in NASA Policy Directive (NPD) 1001.0A, *The 2011 NASA Strategic Plan*, available through NODIS or the Program Library.

The NASA Science Mission Directorate (SMD) addresses these strategic goals by conducting programs of astrophysics science designed to address the following science research objectives:

- Understand the origin and destiny of the universe, and the nature of black holes, dark energy, dark matter, and gravity;
- Understand the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today; and
- Generate a census of extra-solar planets and measure their properties.

Further information on the goals and objectives of NASA's astrophysics programs may be found in the *2010 Science Plan for NASA's Science Mission Directorate*, available at <http://science.nasa.gov/about-us/science-strategy/> or through the Program Library.

2.2 Explorer Program Goals and Objectives

The goal of NASA's Explorer Program is to provide frequent flight opportunities for high quality, high value, focused heliophysics and astrophysics science investigations that can be accomplished under a not-to-exceed cost cap and that can be developed relatively quickly, generally in 36 months or less, and executed on-orbit in less than three years.

The Explorer Program accomplishes these world-class space science investigations utilizing efficient management approaches to contain mission cost through commitment to, and control of, design, development, and operations costs. The Program also seeks to enhance public awareness of and appreciation for space science by incorporating educational and public outreach activities as integral parts of the investigations.

The Explorer Program provides an effective means of timely achievement of strategic goals. By conducting a rapid series of science investigations, NASA is responsive to new knowledge, technology, and science priorities. Pressing questions in heliophysics and astrophysics science are addressed, permitting a steady improvement in our understanding of space science systems and the processes that affect them. The frequent, steady nature of the investigations ensures a continuing stream of fresh scientific data to the broader science community, thus maintaining the

excellence of the U.S. space science program and the inspiration of a new generation of investigators.

The Explorer Program strives to:

- advance scientific knowledge of heliophysics and astrophysics processes and systems;
- add scientific data and other knowledge-based products to data archives for all scientists to access;
- lead to scientific progress and the publishing of results in the peer-reviewed literature to encourage, to the maximum extent possible, the fullest commercial use of the knowledge gained;
- implement technology advancements prepared in related programs; and
- announce scientific progress and results in popular media, scholastic curricula, and materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

2.3 NASA Management of the Explorer Program

The selected investigation(s) will be managed by the Explorer Program. The Associate Administrator for SMD has established the Explorer Program Office at the NASA Goddard Space Flight Center (GSFC) to be responsible for project oversight. The Explorer Program Manager at NASA GSFC reports to the Astrophysics Division Deputy Director at NASA Headquarters. Additional details about the program office staffing, structure, and goals can be found in the *Explorer Program Plan*, available through the Program Library. There are appropriate protective firewalls between the Explorer Program Office and the rest of GSFC, allowing investigators from GSFC to propose in response to this PEA. The Explorer Program Office will manage the Astrophysics Explorer Mission of Opportunity investigations under the requirements of NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, as described in Section 4.1.2 of the SALMON-2 AO. Safety, reliability, and mission assurance requirements for Astrophysics Explorer Mission of Opportunity investigations will be consistent with the *Standard Mission Assurance Requirements* document found in the Program Library.

All references to NPR 7120.5D NID in SALMON-2 should be interpreted as referencing NPR 7120.5E.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

The following schedule applies to this PEA.

- A Preproposal Workshop will take place in association with this solicitation. Further information will be available at the Astrophysics Explorer Mission of Opportunity Acquisition website (<http://soma.larc.nasa.gov/astrophysics/>) prior to the Preproposal Workshop.
- Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA. The period for questions will close two weeks before the proposal due date.
- A Notice of Intent (NOI) to propose to this announcement is extremely valuable to NASA for purposes of planning the proposal evaluation and peer reviews, and, therefore, is encouraged.

NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Section 6.1.2 of the SALMON-2 AO provides information on electronic NOI submission through NSPIRES.

- All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.
- Evaluation and selection for funding will be done using a single step selection process; no competitive Phase A (Step 2) or downselection is planned.
- Normal project Phase A activities will be conducted by the selected investigation team following selection.
- NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four months following receipt of the Statement of Work, as set forth in Section 6.3.1 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Participate in this Proposal Opportunity

Refer to Section 4.2 of the SALMON-2 AO for the policies on participation policy. For this particular PEA, NASA will place full or partial limitations (as described in the SALMON-2 AO) on organizations that will be involved in the evaluation process. Cornell Technical Services LLC is subject to the “Full Limitation” as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on the Aerospace Corporation.

4.2 Types of Mission of Opportunity

Three Mission of Opportunity types may be proposed in response to this solicitation: Partner Missions of Opportunity (PMOs), New Missions using Existing Spacecraft (NMESs), and Small Complete Missions (SCMs), including investigations requiring flight on high-altitude scientific balloon platforms, investigations on the International Space Station (ISS), investigations launched as secondary payloads, or investigations launched as hosted payloads. See Section 5.1 of the SALMON-2 AO for complete descriptions of these types of MOs as well as constraints and requirements for proposals.

A fourth type of investigation, U.S. Participating Investigators (USPIs), may be proposed in response to ROSES-12 Appendix D.11. A USPI proposes to participate as a Co-I for an instrument, experiment, or technology demonstration that is being built and flown by a sponsor agency other than NASA. NASA has released simultaneously with this PEA a solicitation for Astrophysics Explorer U.S. Participating Investigators through the ROSES-12 NASA Research Announcement (NRA) (NNH12ZDA001N). The Explorer USPI program element appendix of the ROSES NRA is available at <http://nspires.nasaprs.com/> or at <http://go.nasa.gov/ROSES12>. USPI proposals submitted to that solicitation will be due at the same times and will be reviewed at the same time by the same science peer review panel as the Astrophysics Explorer MOs. A single selection meeting will select proposals, and all Astrophysics Explorer selections will be funded from the same Astrophysics Explorer future mission budget. There is no separate budget for USPIs. USPI NOIs and proposals will be submitted in response to the ROSES-12 amendment, will be subject to the proposal guidelines specified in ROSES-12, will be subject to

the constraints (cost, schedule, technical) and requirements specified in ROSES-12, and will be reviewed and selected using the proposal criteria specified in ROSES-12.

Investigations intended to be flown on the European Space Agency (ESA) Euclid and Jupiter Icy Moons Explorer (JUICE) missions are not solicited in this PEA. PMO and/or USPI investigations for those missions are solicited through other NASA solicitations, which may be found at <http://nspires.nasaprs.com/>.

4.3 Science Requirements and Constraints

The science objectives are described in Section 2 of this PEA. Any appropriate science question relevant to NASA's astrophysics goals and objectives may be addressed with the proposed investigations. Section 2 of this PEA provides the basis for the evaluation of intrinsic science merit as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside astrophysics science objectives, as described in Section 2 of this PEA, are not solicited.

Requirement L-1. Proposals shall address appropriate science questions relevant to astrophysics science goals and objectives as described in Section 2 of this PEA.

Requirements for documentation in the proposal of the flow-down of requirements from the proposed science goals and objectives are described in Section 5.2.2 of the SALMON-2 AO.

Requirement L-2. Each proposal shall clearly define its science question or questions, shall demonstrate how the science questions map into high-level science requirements, and shall show how the science requirements subsequently map into measurement, data, instrument, and mission requirements.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement L-3. Each proposal shall clearly state the baseline and threshold requirements for the mission and the baseline and threshold mission lifetime.

NASA expects each proposal to fully describe the requirements for calibration and validation of the instruments and the data returned. Other data policies and requirements are given in Section 4.4 of the SALMON-2 AO and Section 4.5.5 of this PEA.

Requirement L-4. Each proposal shall fully describe the requirements for calibration and validation of the instruments and the data returned.

4.4 Cost and Schedule Requirements and Constraints

4.4.1 Cost Requirements and Constraints

The PI-Managed Mission Cost is defined in Section 4.3.1 of the SALMON-2 AO. Except for high-altitude scientific balloon missions, the PI-managed Mission Cost cap for an Astrophysics Explorer Mission of Opportunity, including all mission phases and the cost of accommodation on and/or delivery to the host mission, if applicable, is \$60M in Fiscal Year (FY) 2013 dollars. The

PI-managed Mission Cost cap is \$30M in FY 2013 dollars for high-altitude scientific balloon missions.

NASA expects to select nominally one Astrophysics Explorer Mission of Opportunity. If multiple selectable missions are proposed with combined costs within the available funding (approximately \$60M), NASA may select more than one proposed investigation.

Requirement L-5. Proposals shall be for complete investigations including Phases A-F.

Requirement L-6. The proposed PI-Managed Mission Cost shall be no more than \$60M in FY 2013 dollars, except for high-altitude scientific balloon missions, for which it shall be no more than \$30M in FY 2013 dollars.

Requirement L-7. Proposals shall include detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Mission Cost.

4.4.2 Schedule Requirements and Constraints

For Partner MOs, the proposing PI must provide evidence that the sponsoring organization intends to fund the primary host mission and that the NASA commitment for U.S. participation is required by the sponsoring organization prior to December 31, 2016. The launch date itself for a Partner MO is not constrained.

For Small Complete Mission (SCM) MOs, proposers must specify the launch date in the proposal, which is to be no later than December 31, 2018. Explorer SCM MO investigations with an anticipated launch date requirement later than the end of calendar year 2018 should be proposed in response to a subsequent opportunity.

Proposers should be aware that it may be necessary for NASA to adjust the launch date and definition phasing of selected investigations from that proposed in order to conform to the available Explorer program budget profile and/or NASA's ability to negotiate a launch opportunity to the International Space Station or for a high-altitude scientific balloon mission; therefore, the degree of launch date flexibility must be indicated in the proposal.

Requirement L-8. Proposals shall include a detailed development schedule (including integration plans) and an associated planning budget that for a SCM secures the launch before December 31, 2018, or for a PMO or a NMES is consistent with the documented launch schedule of the primary host mission.

4.4.3 Access to Space Cost Requirements

Access to space will be provided by NASA for missions on the International Space Station (ISS). NASA will also provide balloon vehicles and balloon launch services for missions on high-altitude scientific balloons. In both these cases, access to space (or near-space for balloons) will be provided at no cost to the PI-managed Mission Cost (see Section 4.5.2 of this PEA for additional information).

For all other proposals, including small complete missions launched as secondary or hosted payloads, any costs for access to space must be included in the PI-managed Mission Cost.

Requirement L-9. With the exception of small complete missions to the International Space Station or small complete missions flown on high-altitude scientific balloons, any costs for access to space must be included in the PI-managed Mission Cost.

4.5 Technical Requirements and Constraints

4.5.1 Additional Requirements for Partner Mission of Opportunity Investigations

The following requirements are in addition to those given in Section 5.1.1 of the SALMON-2 AO.

Requirement L-10. In addition to the requirements given in the SALMON-2 AO, all proposed partner MO investigations must also demonstrate: (1) their formal relationship with the sponsoring agency's host mission (e.g., already selected contribution, invited contribution, or proposed contribution); and (2) the status of the host mission within the sponsoring agency (i.e., Pre-Phase A, Phase A, or Phase B), including the level of commitment that the sponsoring agency has made to complete the mission.

Requirement L-11. In addition to the requirements given in the SALMON-2 AO, all proposed partner MO investigations requiring flight on the ISS must also provide a Letter of Acknowledgement from the NASA Space Station Payload Office. This Letter of Acknowledgement must contain: (1) a description of the formal relationship with the sponsoring agency's host mission for access and accommodation at the space station, (2) identification of known challenges and/or conditional provisions for access or accommodation of the host mission, and (3) a description of the level of technical interchange and negotiation required to mature the host mission's provisions for access and accommodation.

Partner MOs may be proposed for participation in nonstrategic NASA missions. A partner MO may be proposed for participation in a PI-led NASA mission from a program other than Explorer (an Explorer MO may not be proposed for an Explorer mission).

Requirement L-12. A proposal for a Partner MO hosted by a PI-led mission from a program other than the Explorer Program must satisfy the following requirements: (1) The proposal must include a Letter of Commitment from the PI of the host mission endorsing the partnership and (2) the feasibility assessment of the host mission, i.e., the technical, management, and cost (TMC) evaluation in Step 1 and Step 2, must include the accommodations for the proposed Partner MO instrument.

4.5.2 Additional Requirements for Small Complete Mission of Opportunity Investigations

The following requirements are in addition to those given in Section 5.1.3 of the SALMON-2 AO.

Requirement L-13. In addition to the requirements given in the SALMON-2 AO, all proposed small complete mission investigations, with the exception of investigations requiring flight on the ISS or small complete missions flown on high-altitude scientific balloons, must also provide a Letter of Commitment from the program or agency providing access to space. This Letter of Commitment must contain: (1) a detailed description of the proposed provisions for access to space (e. g., launch to orbit provided by industrial or non-U.S. partner, secondary ride on another U.S. sponsored mission, etc.), and (2) the status of those proposed flight provisions within the sponsoring program or agency (i.e., conditional, confirmed, conceptual, etc.) including the level of commitment that the sponsoring program/agency has made to support that flight opportunity.

Small complete missions may be proposed for the ISS. Investigations requiring flight on the ISS must provide a Letter of Feasibility from the NASA Space Station Payloads Office.

Requirement L-14. In addition to the requirements given in the SALMON-2 AO, all small complete mission investigations requiring flight on the ISS must also provide a Letter of Feasibility from the NASA Space Station Payload Office demonstrating that the proposed payload to be flown aboard the ISS can meet the access and accommodation requirements for ISS payloads. This Letter of Feasibility must contain: (1) a preliminary assessment of the feasibility of proposed provisions for access to and accommodation on the ISS, (2) identification of known challenges and/or conditional provisions for access or accommodation, and (3) a description of the level of technical interchange and negotiation required to mature the proposed provisions for access and accommodation.

Proposers requiring an ISS Letter of Feasibility should contact Mrs. Sharon Conover, ISS Payload POC, Space Station Research Integration Office, Mail Stop OZ, NASA Johnson Space Center, Houston, TX 77058; Tel: 281-244-8158; E-mail: sharon.c.conover@nasa.gov. Additional information is found through the International Space Station Capabilities and Payload Accommodations Document link in the Program Library. For any selected investigations, flight commitment to the ISS will be negotiated with NASA's Human Exploration and Operations Mission Directorate during Phase A. Selection of any investigation to be flown aboard the ISS is conditional until negotiations for ISS access and accommodation are successfully completed.

An Explorer MO investigation that is a SCM to the International Space Station should plan to complete its primary mission investigations by the end of 2020. NASA currently plans to operate ISS thru 2020, and while the agency is taking no action that would preclude operation beyond 2020, no commitment has yet been made either way.

Small complete missions may be proposed for flight on high-altitude scientific balloons. Small complete missions on high-altitude scientific balloons must be proposed for flight on Long Duration Balloons (LDBs) or Ultra Long Duration Balloons (ULDBs).

Requirement L-15. Proposals for small complete mission of opportunity investigations on high-altitude scientific balloons must be proposed for flight on Long Duration Balloons (LDBs) or Ultra Long Duration Balloons (ULDBs).

Investigations requiring flight on LDBs or ULDBs must provide a Letter of Feasibility from the NASA Balloon Program Office.

Requirement L-16. In addition to the requirements given in the SALMON-2 AO, all small complete mission investigations requiring flight on high-altitude scientific balloons must also provide a Letter of Feasibility from the NASA Balloon Program Office demonstrating that the proposed payload to be flown aboard LDBs or ULDBs can meet the access and accommodation requirements for balloon payloads. This Letter of Feasibility must contain: (1) a preliminary assessment of the feasibility of proposed provisions for access to and accommodation on LDBs or ULDBs, (2) identification of known challenges and/or conditional provisions for access or accommodation, and (3) a description of the level of technical interchange and negotiation required to mature the proposed provisions for access and accommodation.

Proposers requiring a NASA Balloon Program Office Letter of Feasibility should contact Mr. David Gregory, NASA Balloon Program Office, Mail Stop 820.0, NASA Wallops Flight Facility, 34200 Fulton Street, Wallops, VA 23337; Tel: 757-824-2367; E-mail: david.d.gregory@nasa.gov. Additional information is found through the *Science Balloon Missions of Opportunity* document link in the Program Library. For any selected investigations, flight commitment to LDBs or ULDBs will be negotiated with the NASA Balloon Program Office during Phase A. Selection of any investigation to be flown aboard LDBs or ULDBs is conditional until negotiations for access and accommodation are successfully completed.

4.5.3 Payload Risk Classification

This opportunity solicits proposals for science investigations requiring the development and operation of space-based investigations. The projects are designated as Class 3 as defined in NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*. The payloads are designated as Class C (medium priority, medium risk, less than two years primary mission timeline as defined in NPR 8705.4, Risk Classification for NASA Payloads) for Partner Mission of Opportunity investigations or designated as Class D (low priority, high risk, less than two years primary mission timeline as defined in NPR 8705.4, Risk Classification for NASA Payloads) for Small Complete Missions of Opportunity, including investigations on a high-altitude scientific balloon or the ISS.

Requirement L-17. If an investigation requires two or more years to meet the science requirements, the proposal must demonstrate how the instrument will meet that time requirement. If any requirements to the instrument that are more stringent than Class C or Class D (as appropriate) are needed, they must be clearly described in the proposal.

4.5.4 End-of-Mission Spacecraft Disposal

Section 5.3.10 of the SALMON-2 AO discusses the requirements related to end-of-mission spacecraft disposal for Partner Missions of Opportunity and hosted payloads where the PI is not responsible for the host mission. For these proposals, information shall be included regarding the plan for instrument passivation at the end of operations or in preparation for end-of-mission disposal. In addition, information shall be provided identifying instrument system components

expected to survive Earth reentry if this is the postmission disposal method. This will allow NASA to remain in compliance with NPR 8715.6A, NASA Procedural Requirements for Limiting Orbital Debris, and NASA-STD-8719.14, Process for Limiting Orbital Debris.

Requirement L-18. Proposals shall describe the instrument passivation plan at end of mission. In addition, proposals shall identify instrument components anticipated to survive Earth reentry if this is the disposal method. This supersedes Requirement 39 in the SALMON-2 AO.

4.5.5 Science Data Policy

4.5.5.1 Data Analysis

The PI will be responsible for analysis of the investigation data necessary to complete the proposed science objectives, for archiving the data in the relevant NASA astrophysics data archive for public use, and for timely publication of initial scientific results in refereed scientific journals, as part of their mission operations (Phase E) or postmission (Phase F) activities. Proposals must allocate sufficient resources for this data analysis and archiving. Science studies with the archived data sets beyond the PI-led teams proposed science investigation will be solicited and selected by NASA in subsequent NASA solicitations through ROSES NRAs.

Requirement L-19. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final on-orbit calibration and validation of the measurements. In accordance with the SMD requirement for open data and related software, any specialized software and algorithms required for basic data analysis and processing will be made available by the PI to the science community and public.

Requirement L-20. Proposals shall clearly present a plan for analysis of the mission data leading to completion of the proposed science investigation and achieving the identified investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.5.5.2 Data Rights

By NASA policy, all science data returned from NASA investigations led by a NASA-funded PI are made available immediately in the public domain. Following a postflight checkout period, all data will be made available to the user community. There shall be no period of exclusive access. The principal investigator will propose the data product latency period for standard products listed in the proposal, and a justification for it must be demonstrated. Barring exceptional circumstances, data product latency may not exceed six months.

Requirement L-21. Proposals shall include a clear commitment to minimizing the latency for data products. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.5.5.3 *Delivery of Data to Archive*

Mission data will be made fully available to the public by the investigator team in usable form, in the minimum time necessary and, in any case, within the proposed data latency period not to exceed six months following data receipt from the spacecraft. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to making it fully available. By the investigation closeout, the investigation will deliver to the appropriate astrophysics data center all final data products, along with the scientific algorithm software, coefficients, ancillary data used to generate these products, and the algorithm and calibration documentation.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in flight), documentation, related software, and/or other tools or parameters that are necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large and provided within the proposed data latency period not to exceed six months following data receipt from the spacecraft.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of the appropriate NASA data archive.

Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the capped PI-Managed Investigation Cost.

Requirement L-22. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving shall be described. The science products (*e.g.*, flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the formats and standards to be used. It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community.

4.5.5.4 *Sharing of Data from Partner Mission of Opportunity Investigations*

The data that are returned from Partner Mission of Opportunity investigations, at least from those aspects of the mission in which NASA is involved, shall be made available to the U.S. scientific community in a timely way.

Requirement L-23. In addition to the requirements given in the SALMON-2 AO, all proposed Partner MO investigations must also provide: (1) a detailed description of the proposed provisions for sharing of science data, plans that scientific data returned from at least those aspects of the mission in which NASA is involved shall be made available to the U.S. scientific community in a timely way, and the status of the host mission

sponsoring agency's commitment to enter into an appropriate agreement with NASA for data sharing; and (2) a detailed explanation of how the U.S. astrophysics science community benefits from the proposed investigation.

4.6 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are referenced in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.4.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirements and constraints for that specific solicitation, including the sponsoring NASA Headquarters (HQ) mission directorate and division, the type of MO, the cost cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2, the cost cap is specified in Section 4.4.1, and the schedule constraint is specified in Section 4.4.2.
- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. For this PEA, the NASA Center for program office and the safety, reliability, and quality assurance document applicable to selected investigations are specified in Section 2.3.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the payload risk classification is specified in Section 4.5.3.
- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation by Aerospace in proposals. For this PEA, Section 4.1 states that there are no additional restrictions on participation by Aerospace in proposals.
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Mission Cost, the Total Mission Cost, and the Enhanced Mission Cost. For this PEA, that information is specified in Section 4.4.1. Only the PI-Managed Mission Cost is capped.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.4.1 and 4.4.2.
- Section 4.6 of the SALMON-2 AO states that each PEA will identify any NASA-provided launch services. For this PEA, NASA plans for access to space are discussed in Section 4.4.3.
- Section 5.2.5 of the SALMON-2 AO describes Science Enhancement Options (SEOs) for proposed investigations. SEOs are permitted for proposals in response to the PEA, and any SEO proposal must meet the requirements in Section 5.2.5 of the SALMON-2 AO.
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Section 3 that a two-step competitive process is not being used.

- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an Education and Public Outreach program that is consistent with SMD policy is required. This PEA so states, and Requirements 68, 69, and 70 of the SALMON-2 AO apply to this PEA.
- Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA.
- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by SMD and it does not permit contributions of funding from SMD programs other than the funding offered through this PEA.
- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection Official. This PEA identifies the Selection Official in Section 6.2.

4.7 Exceptions to General SALMON-2 Requirements

This PEA contains the following exceptions to the SALMON-2 proposal preparation and submission requirements described in the SALMON-2 AO.

- Proposals or portions of proposals requesting NASA funding shall report proposal costs in FY 2013 dollars as well in Real Year (RY) dollars. The former is for determining compliance with the PI-Managed Mission Cost cap requirement. The latter is for NASA SMD budget planning. This instruction supersedes the request for costs only in RY dollars described in Appendix B of the SALMON-2 AO including Table B-4.
- Section 4.5.5 of this PEA provides data policies and requirements that supersede those in Section 4.4 of the SALMON-2 AO.
- Section 4.5.4 provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO.

5 PROPOSAL PREPARATION AND SUBMISSION

5.1 Proposal Content Requirements

Requirement L-24. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO.

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA reviewers.

The key data associated with the electronic submission of proposals (see Section 6.2 of the SALMON-2 AO) includes questions indicating whether or not a proposal contains export-controlled information (see Sections 5.9.4 and 5.10.2 of the SALMON-2 AO). All proposers must answer these questions YES or NO when completing the electronic submission; these questions shall not be left unanswered.

All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO. To the extent possible, ITAR sensitive material should be organized into separate clearly marked sections.

Requirement L-25. All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO.

5.2 Proposal Submission Requirements

Requirement L-26. Proposals must be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System, at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only.

Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement L-27. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

5.3 Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this appendix, or in the documents available through the Explorer Program Library, should be sent to the E-mail address for questions listed in Section 7 of this PEA. When appropriate, responses will be posted on the website listed in Section 7 of this PEA.

The deadline for receipt of questions is two weeks before the proposal due date listed in Section 7 of this PEA.

6 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

6.2 Selection Process

After the review by the SMD AO Steering Committee, the final evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the final selection(s). As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency, including the Director of the Astrophysics Division, concerning the selections.

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among top-rated proposals, including, but not limited to, planning and policy

considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the mission directorate(s).

6.3 Implementation Activities

Proposal selection and award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO with the following amendments.

6.3.1 Award Administration and Funding of Investigations

Oversight management responsibilities have been assigned to the Explorer Program Office at the Goddard Space Flight Center. The Explorer Program Office will authorize the release of funding to each selected investigation. The initiation of the investigation's award of the contract will take place as soon as possible after notification of selection. In order for contracts to be awarded, Statements of Work (SOWs) and updated cost and pricing data are required. If more than one contractual arrangement between NASA and the proposing team is required, separate SOWs and updated cost and pricing data are required for each contractual arrangement. NASA Centers will receive funding via intra-agency funding mechanisms.

Proposals are not required to include SOWs and cost and pricing data. These will be required only for investigations that are selected for award. For those investigations that are selected, it will be in the best interest of the PI-led investigation management teams to provide SOWs, cost and pricing data, and small business subcontracting plans in as timely a manner as possible. The process of awarding contracts cannot begin until final SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed.

SOWs will be required for selected investigations, regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). For contracts that exceed \$700K, the contractor will be required to provide cost and pricing data to support the cost estimate and to certify the cost proposed for the contract in accordance with FAR 15.406-2. Selected proposers should contact the Explorer Program Office at Goddard Space Flight Center at Tel: 301-286-8212 as soon as possible after award regarding all SOW requirements.

For each selection, and unless otherwise stated in the selection letter, the selected investigation's cost cap will be set at the proposal's proposed cost.

NASA Centers shall follow their standard operation procedure for selecting teaming partners to facilitate the rapid implementation of their proposal, if selected, and this shall be documented in Appendix 6 of the proposal (see Appendix B, Section J.6, of the SALMON-2 AO).

6.3.2 International Agreements

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, the Science Division of NASA's Office of International and Interagency Relations will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-

exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail an exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency MOU. For additional policies and requirements, see Section 5.9 of the SALMON-2 AO.

7 SUMMARY OF KEY INFORMATION

Funding available	See Section 4.4.1 of this PEA
Community Announcement	June 20, 2012
Synopsis Announcement	September 1, 2012
PEA Release Date	September 14, 2012
Date for Preproposal Workshop	September 28, 2012; see the 2012 Astrophysics Explorer MO PEA information page at http://soma.larc.nasa.gov/astrophysics/ for agenda and logistical information.
Due Date for NOI (notice of intent to propose)	11:59 p.m. Eastern Time on October 12, 2012
Due Date for Proposals	11:59 p.m. Eastern Time on December 14, 2012
Web site for additional information for the Astrophysics Explorer MO PEA	http://soma.larc.nasa.gov/astrophysics/
Program Library for the Astrophysics Explorer PEA	http://soma.larc.nasa.gov/astrophysics/programlibrary
Submission Medium	Electronic copies only; see Section 5.2 of this PEA
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)
NASA point of contact	Dr. Wilton Sanders Astrophysics Explorer Program Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-1319 E-mail: wilton.t.sanders@nasa.gov

END OF PEA L

NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)

NNH12ZDA0060-EVI2
PROGRAM ELEMENT APPENDIX (PEA) M:
EARTH VENTURE INSTRUMENT-2

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Notice: Amended on October 15, 2013. This amendment changes the proposal due date for Earth Venture Instrument-2, because of the continuing Government shutdown. The proposal due date is changed from November 7, 2013, to “TBD”. Once the Government resumes work, a new due date will be determined and announced by a future amendment.

Notice: Amended on October 21, 2013. This amendment changes the proposal due date for Earth Venture Instrument-2, because of the recent Government shutdown. The proposal due date is changed from “TBD” to November 25, 2013.

NNH12ZDA006O
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)

NNH12ZDA006O-EVI2
PROGRAM ELEMENT APPENDIX (PEA) M:
EARTH VENTURE INSTRUMENT-2

1 BACKGROUND

1.1 Programmatic Overview

The National Aeronautics and Space Administration (NASA) Science Mission Directorate (SMD) Earth Science Division's Earth Venture (EV) mission portfolio is an element within the Earth System Science Pathfinder (ESSP) Program. Earth Venture missions consist of a series of regularly solicited, competitively selected, cost and schedule constrained Earth science investigations as recommended by the most recent National Research Council's decadal survey in Earth science, *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (The National Academies Press, 2007), available at http://www.nap.edu/catalog.php?record_id=11820.

The goal of NASA's Earth Venture mission portfolio is to provide frequent flight opportunities for high quality, high value, focused Earth science investigations that can be accomplished under a not-to-exceed cost cap and that can be developed and flown relatively quickly, generally in five years. The investigations will be principal investigator (PI) led and will be selected through an open competition to ensure broad community involvement and encourage innovative approaches.

The programmatic objectives of the Earth Venture mission portfolio are to implement missions that will:

- advance scientific knowledge of Earth science processes and systems;
- add scientific data and other knowledge-based products to data archives for all to access;
- result in scientific progress and results published in the peer-reviewed literature to encourage, to the maximum extent possible, the fullest commercial use of the knowledge gained;
- provide opportunities to expand the pool of well-qualified Principal Investigators and Project Managers for implementation of future NASA missions;
- implement technology advancements accomplished through related programs; and
- communicate scientific progress and results through popular media, scholastic curricula, and outreach materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

The EV investigations will accomplish high quality Earth science investigations utilizing efficient management approaches to contain mission cost through commitment to, and control of, design, development, and operations costs.

This solicitation calls for proposals for complete PI-led science investigations requiring spaceflight instrument development. The term “complete” encompasses investigation phases from project initiation, through instrument development and science operations, to scientific analysis of space based data. When deployed on a satellite selected by NASA, these spaceflight instruments will be used to conduct innovative, integrated, hypothesis or scientific question-driven investigations addressing pressing Earth system science issues.

This solicitation solicits investigations addressing any of the science focus areas in NASA’s Earth Science program (see Section 2.1 for a description of the focus areas). Investigations may target any Earth science question or issue in order to advance the strategic goals outlined in Section 2.1, answer any of the science questions for Earth Science from Appendix 1 of the *2010 Science Plan for NASA’s Science Mission Directorate* (hereafter the *2010 Science Plan*; available at <http://science.nasa.gov/about-us/science-strategy/>), or address any of the science area objectives for Earth Science also from Appendix 1 of the *2010 Science Plan*.

Investigations that address NASA goals in other areas such as heliophysics, astrophysics, or planetary science are not solicited in this solicitation. Priority will be given to cost-effective, innovative instruments with demonstrable reliability, rather than ones with excessive technology development requirements. Investigations that focus on establishing entirely new research avenues or demonstrating key applications-oriented measurements are solicited.

A key to the success of the Earth Venture portfolio will be maintaining a steady and predictable stream of opportunities for community participation and innovative idea development. This requires that strict schedule and cost guidelines be enforced on the selected EV missions and mission teams.

1.2 Earth Venture Background

The National Research Council’s decadal survey in Earth science recommended that NASA maintain a line of competitively selected, moderate size missions and opportunities in the Earth Venture mission portfolio. The first airborne science investigations funded under the Earth Venture element (called EVS-1) are now in operations. The second Earth Venture element (called EVM-1) solicited and selected a cost constrained standalone space mission that is now in development. Earth Venture is being implemented in the broader context of NASA’s Earth Science program and is intended to result in more frequent opportunities than afforded by the strategic and directed missions outlined in the decadal survey.

The following foci have been identified for the Earth Venture-class missions:

- measurement and observation innovations;
- demonstration of innovative ideas allowing the use of existing moderately higher-risk technologies or approaches;
- establishment of new research avenues; and
- possible demonstration of key application-oriented measurements.

The selection criteria for EV missions are based primarily on the direct science return from the measurement.

The National Research Council's decadal survey in Earth science and applications has recommended three types of Earth Venture-class missions. Through the Earth Venture mission portfolio, NASA intends to obtain a mix of suborbital, instrument, and complete spaceflight mission investigations. To achieve this mix, three different kinds of solicitations are being pursued under the Earth Venture-class line.

- *EV Suborbital* (i.e., EVS-1, 2, 3, ...). These solicitations call for proposals for complete suborbital, PI-led investigations to conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The next of these is EVS-2, whose solicitation was released in June 2013. Not solicited in this solicitation.
- *EV-Mission* (i.e., EVM-1, 2, 3, ...). These solicitations call for proposals for complete PI-led spaceflight missions to conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The EV-2 (or EVM-1 by the new EV naming scheme) solicitation was the first of these, with the selected mission now in development. The next solicitation in this series is anticipated in 2015. Not solicited in this solicitation.
- *EV Instrument* (e.g., EVI-1, 2, 3, ...). These solicitations call for developing instruments for participation on a NASA-arranged spaceflight mission of opportunity to conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The NASA funded PI will retain a central role on the instrument or instrument package development, integration and testing, calibration, and science operations. This is the second solicitation in this series, with the selection(s) expected in 2014. Subsequent solicitations in this series are anticipated every 18 months thereafter (or shortly after the selection announcement of the previously solicited EVI). Solicited in this solicitation.

All Earth Venture-class spaceflight missions require a schedule for launch (or delivery for platform integration in the case of EVI) within five years of project initiation and projects are cost-capped. The Earth Venture class is not intended to be a mechanism for accelerating the implementation of decadal survey missions. However, it is also possible and acceptable that an instrument selected and developed through this solicitation could address significant portions of missions or measurements identified by the decadal survey.

This is the second solicitation in the Earth Venture series soliciting for instruments to be provided for Missions of Opportunity (MOs). The third solicitation in this series is anticipated to be 18 months after the release of EVI-2 and not before the selection announcement for EVI-2.

1.3 Overview of this Program Element Appendix

NASA issues this Program Element Appendix (PEA) as an appendix of the Second Stand Alone Missions of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO) for the purpose of soliciting proposals for Mission of Opportunity (MO) investigations to be

implemented through the Earth Venture Instrument (EVI) portion of the Earth System Science Pathfinder (ESSP) Program. All investigations proposed in response to this solicitation must support the goals and objectives of the ESSP Program and the EVI element (Section 2.1) and must be implemented by Principal Investigator (PI) led investigation teams (Section 5.4 of the SALMON-2 AO). Two types of investigations are solicited: Instrument Investigations and CubeSat Investigations.

Instrument Investigations must encompass the provision of a flight qualified spaceflight instrument or instrument package ready for integration to a spacecraft (Phase A-C), the technical support for integration onto a NASA-determined spacecraft (Phase D, see Section 4.4.1), the on-orbit operations, and the delivery of science quality data (Phase E), as described in Section 4.1 of the SALMON-2 AO.

CubeSat Investigations must encompass the provision of CubeSats (instrument and flight systems) ready for integration to the launch vehicle (Phases A-D), the technical support for integration onto a NASA-determined launch vehicle (part of Phase D, see Section 4.4.1), the on-orbit operations, and the delivery of science quality data (Phase E), as described in Section 4.1 of the SALMON-2 AO.

Proposals submitted in response to this PEA will be evaluated and selected through a single step competitive process. As the outcome of this single step, NASA intends to select at least one proposed investigation to proceed to mission development for flight and operations. If more than one proposal is deemed selectable such that combined costs are within the available funding (as defined in Section 4.4.1), NASA may select more than one investigation in response to this solicitation.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO contains additional requirements on the format and content of the proposals. Documents available in the EVI-2 Library at http://essp.larc.nasa.gov/EVI-2/evi-2_library.html are intended to provide guidance for investigations selected; they are specifically not intended to impose requirements on proposals.

1.4 NASA On-line Document Information System

NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents are available through the NASA On-line Document Information System (NODIS) at <http://nodis3.gsfc.nasa.gov/>.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 NASA Earth Science Goals

One of NASA's strategic goals is to "Advance Earth System Science to meet the challenges of climate and environmental change." Further information on NASA's strategic goals may be found in the most recent version of the *NASA Strategic Plan*, available at http://www.nasa.gov/offices/ocfo/budget/strat_plans.html, and in the *2010 Science Plan for*

NASA's Science Mission Directorate, available at <http://science.nasa.gov/about-us/science-strategy/>.

From space, NASA satellites can view the Earth as a planet and enable its study as a complex, dynamic system with diverse components: the oceans, atmosphere, continents, ice sheets, and life itself. The nation's scientific community can thereby observe and track global-scale changes connecting cause to effects, study regional changes in their global context, and observe the role that human civilization plays as a force of change. Through partnerships with agencies that maintain forecast and decision support systems, NASA improves national capabilities to predict climate, weather, and natural hazards; manage resources; and craft environmental policy.

NASA's Earth science research aims to acquire deeper scientific understanding of the components of the Earth system, their interactions, and the consequences to life due to changes in the Earth system. These interactions occur on a continuum of spatial and temporal scales ranging from short-term weather to long-term climate and motions of the solid Earth and from local and regional to global changes. They involve multiple, complex, and coupled processes that affect climate, air quality, water resources, biodiversity, and other features that allow our Earth to sustain life and civilization. A challenge is to predict changes that will occur in the next decade to century, both naturally and in response to human activities. This requires a comprehensive scientific understanding of the entire Earth system, in particular how its component parts and their interactions have evolved, how they function, and how they may be expected to further evolve on all time scales.

NASA's Earth Science program advances knowledge of the integrated Earth systems and strives to advance goals in six Science Focus Areas and their component disciplinary programs. The six focus areas and their main aims as articulated in the *2010 Science Plan* are as follows:

- **Atmospheric Composition:** understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition;
- **Weather:** enabling improved predictive capability for weather and extreme weather events;
- **Carbon Cycle and Ecosystems:** quantifying, understanding and predicting changes in Earth's ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity;
- **Water and Energy Cycle:** quantifying the key reservoirs and fluxes in the global water cycle and assessing water cycle change and water quality;
- **Climate Variability and Change:** understanding the roles of ocean, atmosphere, land, and ice in the climate system and improving predictive capability for future evolution; and
- **Earth Surface and Interior:** characterizing the dynamics of the Earth surface and interior and forming the scientific basis for the assessment and mitigation of natural hazards and response to rare and extreme events.

NASA's activities encompass the global atmosphere; the global oceans, including sea ice; land surfaces, including snow and ice; ecosystems; and interactions between the atmosphere, oceans,

land, and ecosystems, including humans. A key strategic element is sustained simultaneous observation to unravel the complexity of the global integrated Earth system.

2.2 Accommodation of EV Instruments and Launch of EV CubeSats

The objective of this solicitation is to select one or more Instrument Investigation(s) where an instrument(s) is built and deployed on an existing or planned spacecraft and/or one or more CubeSat Investigation(s) where CubeSats are developed and ride to space on an available launch vehicle, followed by production of high quality and highly useful Earth Science data from that instrumentation. Instrument investigations will be proposed without a firm identification of the spacecraft to accommodate these instruments and CubeSat Investigations will face uncertainty on the access to space. Therefore, selection of proposals from this solicitation will take into account the “accommodability” of the proposed instruments and/or the access to space for proposed CubeSats, as well as the value of the science to be returned from the selected investigations.

Many satellites that will be launched to orbits appropriate for observations of the Earth System are expected to have capacity to accommodate Instrument Investigations. These spacecraft could be developed by NASA (including the International Space Station), other U.S. agencies, foreign space agencies, or commercial vendors. In order to take advantage of excess payload capacity on any of these platforms, NASA is planning to build instruments to have available, or nearly available, for inclusion on these various spacecraft. The available capacity including size, weight, power, thermal control, pointing stability, pointing ability, orbits, and data rates for each potential platform will vary, but in general the platform requirements and capacities will be defined by their primary payloads. The instruments provided through this PEA will have to work within the available resources. Hence, there will be some constraints on the specifications of any instruments potentially selected for development through this EV Instrument-2 PEA. Proposed instruments that cannot meet many of the requirements anticipated for most potential platforms will be seen as a higher risk for accommodation than those that have higher specification margin.

NASA has initiated a CubeSat Launch Initiative and begun regularly providing launch opportunities for CubeSats as secondary payloads on U.S. Government missions. The CubeSat Launch Initiative is managed by the NASA Human Exploration and Operations Mission Directorate; see http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html.

For further information, please contact:

Anne E. Sweet,
Launch Services Program Executive,
Phone: 202-358-3784,
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or

Jason C Crusan,
Chief Technologist for Human Exploration and Operations
Phone: 202-358-0635,
E-mail: jason.c.crusan@nasa.gov

2.3 NASA Management of the Earth Venture Program

The selected investigation(s) will be managed by the Earth System Science Pathfinder (ESSP) Program. The Associate Administrator for SMD has established an ESSP Program Office (ESSP PO) at the NASA Langley Research Center (LaRC) to be responsible for project oversight. The ESSP Program Manager at NASA LaRC reports to the Associate Director for Flight Programs within the Earth Science Division at NASA Headquarters. Additional details about the program office staffing, structure, and management approach can be found in the *ESSP Program Plan*, available through the EVI-2 Library. There are appropriate protective firewalls between the ESSP Program Office and the rest of LaRC, allowing investigators from LaRC to propose in response to this PEA. ESSP PO will manage the EVI investigations under the requirements of NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, as described in Section 4.1.2 of the SALMON-2 AO.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

This solicitation is an appendix to the NASA SALMON-2 AO. The SALMON-2 AO provides the overall structure and guidelines for several types of mission of opportunity solicitations. Each new opportunity is announced with a Program Element Appendix (PEA). This document is such a PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com> and at <http://go.nasa.gov/SALMON2-AO>.

This PEA solicits Earth science investigations that include the development of instruments to be provided to and integrated with yet-to-be-identified space platforms and/or the development of CubeSats to be provided to and integrated with yet-to-be-identified launch vehicles.

Evaluation and selection will be done using a single step selection process; no competitive Phase A (Step 2) or down selection is planned. Normal instrument Phase A activities will be conducted by the selected investigation team or teams following selection.

The following schedule applies to this PEA.

- A Preproposal Workshop will take place in association with this solicitation. Further information will be available at the Earth Venture Instrument-2 PEA Additional Information Homepage (see Section 7 of this PEA) prior to the Preproposal Workshop.
- Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA. The period for questions will close two weeks before the proposal due date.
- A Notice of Intent (NOI) to propose to this announcement is REQUIRED for this solicitation. It is desired by SMD that all NOIs have the entire investigation team identified within the NOI to allow for the identification of unconflicted evaluators by the proposal due date. SMD requests that proposers communicate any changes to the investigation team between NOI and proposal submission to the EVI-2 Program Scientist identified in Section 7 of this PEA. NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Section 6.1.2 of the SALMON-2 AO provides information on

electronic NOI submission through NSPIRES. Submitting an NOI does not commit the team to submitting a proposal.

- All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.
- NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four months following receipt of the Statement of Work, as set forth in Section 6.3.1 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Propose

Refer to Section 4.2 of the SALMON-2 AO for the rules on participation policy. For this particular PEA, NASA will place full or partial limitations (as described in the SALMON-2 AO) on organizations that will be involved in the evaluation process. Cornell Technical Services LLC (CTS) is subject to the “Full Limitation” as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on The Aerospace Corporation for EVI-2.

4.2 Type of Mission of Opportunity

In the context of the SALMON-2 AO, this PEA is a Focused Mission of Opportunity (FMO). A FMO is one that addresses a specific, NASA-identified flight opportunity that fulfills the solicited objectives and includes all of the elements specified in this document and in the SALMON-2 AO.

The investigation PI is responsible for conducting the proposed science investigation which includes, but is not limited to: (i) development and delivery of the instrument, instrument package, and/or CubeSat(s); (ii) working with NASA to integrate the instrument on the NASA-chosen platform and/or the complete CubeSat(s) onto the NASA-determined launch vehicle; (iii) commissioning, validating, and operating the instrument and/or CubeSat(s) and ground systems on-orbit in order to carry out the proposed science investigation; (iv) preparing and delivering appropriate data analysis software, including required calibration data, analyzing the data, publicly distributing all the proposed investigation data from the prime mission phase to the scientific community, archiving the data in a NASA-chosen Distributed Active Archive Center (DAAC), and reporting the results of the science investigation in the scientific literature.

4.3 Science Requirements and Constraints

The science requirements are fully described in Section 2 of this PEA. Any appropriate science question relevant to Earth system science can be addressed with the proposed investigations. Section 2 provides the basis for the evaluation of intrinsic science merit as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside Earth system science as described in Section 2 are not solicited through this call.

Requirement M-1. Proposals shall address appropriate science questions relevant to Earth system science as described in Section 2 of this PEA.

Requirement M-2. Each proposal shall clearly define its science question or questions, shall demonstrate how the science questions map into high-level science requirements, and shall show how the science requirements subsequently map into the measurement and instrument performance requirements.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement M-3. Each proposal shall clearly state the baseline and threshold requirements for the performance of the instrument, the prime mission lifetime for operation of the instrument, and range of satellite orbits acceptable or required for deployment of the instrument.

Requirement M-4. Proposals shall designate all Co-Is, describe the role of each Co-I in the development of the mission, and justify the necessary nature of the role; see Section 5.6 of the SALMON-2 AO.

Each observation from space has natural synergies with other observations. Some proposed observations may either require or desire other observations in order to better address the science questions as proposed for the investigation. Some of these observations may be currently existing or planned either from other NASA missions or from missions by other U.S. or non-U.S. agencies. Proposers are expected to clearly state any dependencies on other data sets, what assumptions are made on the likelihood that these observations will exist during potential time frames for operation of their proposed investigations, and the implications if those observations do not exist.

Requirement M-5. Each proposal shall clearly outline which ongoing or planned set of observations, if any, are required for the proposed investigation to achieve its baseline mission science investigation. The proposal shall describe how the high-level science requirements will be impacted if such observations do not exist when the proposed investigation is in operation.

Most NASA Earth science observations from space require stringent and well-defined calibration and validation plans. NASA expects each proposal to fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the selected PI led investigation, the proposals should provide information about the commitment to funding for those data in the time line of 5-10 years after selection of the investigation and describe the implications to meeting the science requirements if such data do not exist.

Requirement M-6. Each proposal shall fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the selected PI led investigation, the proposals should provide information about the expectations for available calibration and validation instruments and/or data in the time line of 5-10 years

after selection of the investigation and describe the implications to meeting the science requirements if such activities do not exist.

4.4 Cost and Schedule Requirements and Constraints

4.4.1 Cost Requirements and Constraints

The PI-Managed Mission Cost cap for an Earth Venture Instrument investigation depends on the instrument class as described in Section 4.5.4 of this PEA. For Class D instrument based investigations or for CubeSat based investigations, the cost cap is \$30M in (FY) 2016 dollars. For Class C instrument based investigations, the cost cap is \$94M in (FY) 2016 dollars.

NASA expects to select at least one Class C EVI instrument based investigation, or up to three Class D investigations, or some combination of Class C and Class D investigations that combined are less than \$94M, assuming all such investigations are deemed selectable.

Each selected investigation is PI-Managed, and the PI will be responsible for defining and controlling the costs within the proposed budget for each phase of the investigation. Since NASA will be arranging the spacecraft for the Instrument Investigation(s) and access to space for CubeSats, some costs cannot be defined and controlled by the PI, and these costs will be outside the constrained PI-Managed Mission Cost. This section identifies those costs that are constrained within the PI-Managed Mission Cost and those where NASA requires planning budgets that are outside the constrained PI-Managed Mission Cost. A summary of budgeted costs that are and are not to be included in the PI-Managed cost cap for Instrument Investigations is listed in Table 1 and for CubeSat Investigations is listed in Table 2.

The ESSP Program's planning budget can accommodate one or more selection(s) totaling the cost cap with a typical (combined) funding profile over a nominal five-year development period for instrument delivery. Proposers should propose a funding profile that is appropriate for their investigation. However, NASA cannot guarantee that every proposed funding profile can be accommodated within the ESSP Program's budget. The inability of NASA to accommodate the requested funding profile may be a reason for nonselection of a proposal. A final funding profile for all selected investigations will be negotiated between the ESSP Program and the selected investigation team.

Requirement M-7. Proposals shall be for complete investigations including Phases A-F.

Requirement M-8. The proposed PI-Managed Mission Cost shall be no more than \$94M in FY 2016 dollars for a Class C instrument based investigation. The PI-managed cost shall be no more than \$30M in FY 2016 dollars for any Class D instrument or any CubeSat based investigation. The PI-Managed Mission Cost for Instrument Investigations excludes the integration of the instrument to the selected platform and for CubeSat Investigations excludes the integration of the CubeSat to the selected launch vehicle and launch services. All proposals shall include proposed science team, instrument personnel, and key management and engineering staff activity in Phase D. Proposals shall assume two years for Phase D.

Requirement M-9. Proposals shall include detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Mission Cost (see Tables 1 and 2).

4.4.1.1 *Instrument Investigation Cost Requirements and Constraints*

For Instrument Investigations, costs that are within the PI-Managed Mission Cost include: instrument delivery ready for integration onto the selected platform (Phases A-C); development and delivery of functional algorithms and ground processing system (Phases B-D); supporting a science team that will contribute directly to the successful implementation of the investigation (Phases A-F); required calibration and validation activities (Phases C-E); operations, product generation, and data analysis during the proposed prime mission lifetime of the investigation (Phases E); and close out of the investigation once the investigation has been concluded (Phase F). The PI-Managed Mission Cost also includes the cost of the science team and of key management, instrument, and engineering staff during Phase D, as this is not expected to be dependent on the final platform of the selected investigation. For support of the science team and key management and engineering during Phase D, a two-year duration should be assumed for budgeting purposes.

It is expected that once an appropriate platform is determined (preferably before the Preliminary Design Review) minor changes to the selected instrument will be required. Appropriate budget margin should be planned to account for such changes.

Costs that are outside the PI-Managed Mission Cost include integration to the NASA selected platform (Phase D); and investigation costs during any potential gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D).

For planning purposes, the proposal must include estimates of budgets for Phase D (nominally two years) for costs that would be outside the PI-Managed Mission Cost identified above for Phase D. It is understood that final Phase D cost will be dependent on the selected platform for the instrument and the actual time frame for each development phase.

NASA also requires proposals to include plans and planning budgets that estimate the minimum costs for the project if there is a gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D). These “gap planning” budgets should be on a per-year basis up to a maximum of four years. The costs for both of these planning budgets are outside of the PI-Managed Mission Cost.

Table 1: List of which portions of an Instrument Investigation are within and outside the PI-Managed Mission Cost. Budgets for both are required in each proposal.

Portion of the Investigation	Within PI-Managed Costs	Outside PI-Managed Costs
Phase A	X	
Phase B	X	
Phase C	X	
Investigation Costs during a potential gap between completion of instrument and start of integration (planning budget up to 4 years, on a per-year basis)		X
Science Team activity within Phase D	X	
Key management and engineering staff during Phase D (Project manager, instrument manager, systems engineer, etc.) assuming a 2 year Phase D	X	
Integration and test to selected platform (within Phase D) (planning budget nominally 2 years)		X
Cal/Val planning (all phases)	X	
Postlaunch instrument commissioning activity (within Phase D)	X	
Phase E	X	
Phase F	X	
Cost for access to space		X
Core E/PO program, not required, see section 4.6.		X
Student Collaboration (SC) (optional)	X – any SC cost above 1% of the PI-Managed Mission Cost	X - Up to 1% of the PI-Managed Mission Cost

Requirement M-10. Instrument Investigation proposals shall include integration plans and planning budgets that occur during Phase D, with the assumption that this phase will take two years. With the exception of the PI-Managed science, investigation management, and engineering cost for Phase D identified in Table 1, these costs are outside the PI-Managed Mission Cost.

Requirement M-11. Instrument Investigation proposals shall include plans and planning budgets for the required costs to minimally support the project and science during a potential gap between instrument delivery (end of Phase C) and the start of integration with the spacecraft (start of Phase D). These budgets should be on a per year basis for up to four years. These costs are outside the PI-Managed Mission Cost.

4.4.1.2 *CubeSat Investigations Cost Requirements and Constraints*

For CubeSat Investigations, all costs are inside the PI-Managed Mission Cost except the cost associated with integration and launch of the CubeSats on the NASA selected launch vehicle(s), as identified in Table 2.

Once an appropriate launch vehicle is determined (preferably before the Preliminary Design Review) minor changes to the CubeSat(s) may be required. Appropriate budget margin should be planned to account for such changes.

Costs that are outside the PI-Managed Mission Cost include integration to the NASA selected launch vehicle (part of Phase D); and investigation costs during any potential gap between the delivery of the completed CubeSat(s) (part of Phase D) and the start of integration to the designated launch vehicle (part of Phase D).

For planning purposes, the proposal must include estimates of budgets for part of Phase D (nominally one year) for costs that would be outside the PI-Managed Mission Cost identified above for Phase D. It is understood that final Phase D cost will be dependent on the selected launch service and the actual time frame for each development phase.

NASA also requires proposals to include plans and planning budgets that estimate the minimum costs for the project if there is a gap between the delivery of the completed CubeSat(s) (part of Phase D) and the start of integration of the CubeSat(s) to the designated launch vehicle (part of Phase D). These “gap planning” budgets should be on a per year basis up to a maximum of two years. The costs for both of these planning budgets are outside of the PI-Managed Mission Cost.

Table 2: List of which portions of a CubeSat Investigation are within and outside the PI-Managed Mission Cost. Budgets for both are required in each proposal.

Portion of the Investigation	Within PI-Managed Costs	Outside PI-Managed Costs
Phase A	X	
Phase B	X	
Phase C	X	
Phase D (integration of instrument(s) to CubeSat(s) and delivery of CubeSat(s) to Launch Services)	X	
Investigation Costs during a potential gap between completion of CubeSat(s) and start of integration to launch vehicle (planning budget up to 2 years, on a per-year basis)		X
Science Team activity within Phase D	X	
Key management and engineering staff during Phase D (Project manager, instrument manager, systems engineer, etc.)	X	
Integration and test to selected launch vehicle (within Phase D) (planning budget nominally 1 year)		X
Cal/Val planning (all phases)	X	
Postlaunch instrument commissioning activity (within Phase D)	X	
Phase E	X	
Phase F	X	
Cost for access to space		X
Core E/PO program, not required, see section 4.6.		X
Student Collaboration (SC) (optional)	X – any SC cost above 1% of the PI-Managed Mission Cost	X - Up to 1% of the PI-Managed Mission Cost

Requirement M-12. CubeSat Investigation proposals shall include launch vehicle integration plans and planning budgets that occur during this part of Phase D, with the assumption that this part of Phase D will take one year. With the exception of the PI-Managed science and engineering cost necessary for this portion of Phase D, these costs are outside the PI-Managed Mission Cost.

Requirement M-13. CubeSat Investigation proposals shall include plans and planning budgets for the required costs to minimally support the project and science during a potential gap between CubeSat delivery (part of Phase D) and the start of integration with the launch vehicle (part of Phase D). These budgets should be on a per year basis for up to two years. These costs are outside the PI-Managed Mission Cost.

4.4.2 *Schedule Requirements and Constraints*

Each selected Class C instrument investigation under this EVI solicitation will be expected to deliver an instrument that can be integrated onto a NASA-determined platform by March 31, 2019. Nominally, the selected investigation(s) will span the years of FY 2014-FY 2019. This is expected to cover development Phases A through C. Proposals that include a more rapid instrument development timelines may be selected, provided the required budget phasing can be accommodated by NASA.

Each selected Class D instrument or CubeSat investigation under this EVI solicitation will be expected to deliver an instrument that can be integrated onto a NASA-determined platform and/or a CubeSat(s) that can be integrated to a NASA-determined launch vehicle by March 31, 2018. Nominally, the selected investigation(s) will span the years of FY 2014-FY 2018. This is expected to cover development Phases A through C (or into Phase D for CubeSats). Proposals that include more rapid instrument development timelines may be selected, provided the required budget phasing can be accommodated by NASA.

It is expected that once an appropriate platform and/or launch service is determined by NASA, preferably before the Preliminary Design Review, minor changes to the selected instrument and/or CubeSat(s) will be required. Appropriate schedule margin should be planned to account for such changes.

Requirement M-14. For Class C instrument investigations, proposals shall include a development schedule that delivers an instrument for integration onto the selected platform no later than March 31, 2019. For Class D instrument or CubeSat investigations, proposals shall include a development schedule that delivers an instrument for integration onto the selected platform and/or a CubeSat(s) that can be integrated to a launch vehicle no later than March 31, 2018.

4.5 Technical Requirements and Constraints

4.5.1 *Instrument Investigation Science Instrument System and Platform Interfaces*

Because there is no defined platform that directly limits the design of the proposed instrument characteristics and observing strategy, this PEA does not list specific requirements for mass, instrument dimensions, power consumption, data rate requirements, platform stabilization requirements, observational geometry requirements, launch vibration constraints, or desired orbit. However, all of these characteristics must be well characterized and clearly stated within the proposal in order for NASA to determine the feasibility of finding an appropriate platform in the near future to deploy any potential selected instrument.

Instruments that have less stringent and more easily accommodated requirements will be considered more desirable for selection, providing they return high value science, as they are more flexible in being accommodated by the range of potential platforms available in the near future.

Requirement M-15. Proposals for instrument investigations that will be accommodated on a NASA selected platform shall clearly state the proposed instrument mass, volume

dimensions, power requirements, platform stabilization requirements, thermal requirements, observational geometry requirements, launch vibration constraints, electromagnetic interference/electromagnetic compatibility (EMI/EMC) requirements, data rate requirements, and all other requirements (or constraints, preferences, etc.) that the instrument places on the platform for accommodation, launch, deployment, operations, etc. A template is provided on the EVI-2 Library to aid proposers to provide this data. This table shall be provided in the experiment implementation section (Section E) of the proposal. This table does not count towards the proposal page limit.

NASA has begun the process of cataloguing the potential platforms that will exist over the next decade with capacity to accommodate a potential EVI Instrument. The goal of this activity is to document, as a service to both NASA and all who are interested in potential integration of instruments on available payloads, the types of opportunities that exist and the current interfaces and constraints that exist for each potential platform. It is also desired that, as much as possible, agreements can be reached as to potential common instrument interfaces for many of these potential platforms. Documentation of this Common Instrument Interface (CII) work will be available through links in the EVI-2 Library.

One result of this work is to determine the relative probabilities of NASA identifying a feasible opportunity platform for any potential or proposed EVI instrument. A proposed instrument with a high probability of being compatible with several potential platforms is more likely to be selected than an instrument with less flexible accommodation and orbit requirements (see Section 6.2).

Compared with other candidate platforms, the International Space Station (ISS) may be able to accommodate instruments with higher requirements for mass, volume/dimensions, power, and thermal control. Proposers should state whether the ISS is a potential platform for their instrument and identify the tradeoffs of using the ISS orbit vs. other orbits. Even though NASA has current plans to support ISS operations through 2020, any instrument that is appropriate for the ISS should describe an adequate timeline of development and operation for the proposed investigation, regardless of whether it is completed by the end of 2020. Differences between the investigation's timeline and NASA's plans for future ISS operations will be factored into the proposal's risk assessment for selection.

Proposals may include information on any research the proposing team has done relative to potential payload accommodations for their proposed instrument. This is not a requirement for any proposal. However, such information can serve to demonstrate to NASA the potential of finding one or more opportunities for accommodating the proposed instrument. If a proposal includes such information, effort should be made to address all known integration criteria and make clear which integration criteria have not been completely researched. Failure to include such research will not be counted against a proposal in evaluation. Inclusion of such information has the potential to support the arguments within a proposal that the instrument has an acceptable chance of being integrated on a platform within an appropriate time frame.

4.5.2 *CubeSat Investigations*

For CubeSat proposals, all instruments/small satellites are recommended to comply with Cal Poly CubeSat Developer's specifications, found at <http://cubesat.calpoly.edu/index.php/documents/developers>. Concepts that do not comply with the Cal Poly CubeSat and Poly Picosat Orbital Deployer (P-POD) standards should clearly describe how their designs are packaged and deployed. NASA Launch Services Program (LSP) has a Program Level Poly-Picosatellite Orbital Deployer (PPOD) and CubeSat Requirements Document (http://www.nasa.gov/pdf/627972main_LSP-REQ-317_01A.pdf) with requirements for CubeSats sized up to 3U. All proposals for CubeSats sized up to 3U shall be compliant with these requirements. Both of these documents can also be found in the EVI-2 Library listed in Section 7 of this PEA. Investigations may propose to utilize a 6U configuration (2U x 3U). The LSP Users Guide referenced above does not address the specific configuration requirements for a 6U form factor CubeSat at this time. Upon selection investigations requiring a 6U CubeSat must work closely with the CubeSat Launch Initiative (CSLI) program to define the interface requirements so that the satellite will be compatible with the 6U standard that KSC/LSP adopts. No CubeSat form factors larger than 6U will be considered under the present call. Qualifying CubeSat form factors (size) include 1U, 1.5U, 2U, 3U and 6U with a mass not to exceed 1.33 kg per U.

Requirement M-16. All proposals involving sizes 1U through 3U CubeSats shall be compliant with the requirements in the NASA Launch Services Program Level Poly-Picosatellite Orbital Deployer (PPOD) and CubeSat Requirements Document. Investigations may propose to utilize a 6U configuration (2U x 3U). The LSP Users Guide referenced above does not address the specific configuration requirements for a 6U form factor CubeSat at this time. Upon selection investigations requiring a 6U CubeSat must work closely with the CSLI program to define the interface requirements so that the satellite will be compatible with the 6U standard that KSC/LSP adopts. No CubeSat form factors larger than 6U will be considered under the present call. Qualifying CubeSat form factors (size) include 1U, 1.5U, 2U, 3U and 6U with a mass not to exceed 1.33 kg per U.

4.5.3 *Orbit Requirements*

Requirement M-17. Proposals shall clearly state the desired and acceptable orbits and operational constraints (e.g., duty cycle or observational cadence) and describe the relative scientific merits of each possible orbit.

4.5.4 *Payload Risk Classification*

This opportunity solicits proposals for science investigations requiring the development and operation of space-based instruments in one of two designations; Class C (medium priority, medium risk, less than two years primary mission timeline as defined in NPR 8705.4, *Risk Classification for NASA Payloads*) on a platform to be identified by NASA at a later date; or Class D (low priority, high risk, less than two years primary mission timeline as defined in NPR 8705.4, *Risk Classification for NASA Payloads*). CubeSats are designated as Class D. Section 4.4.1 describes the cost caps for Class C vs. Class D instruments.

Requirement M-18. If an investigation requires operation on-orbit for two or more years to meet the science requirements, the proposal must demonstrate how the instrument will meet that time requirement. If any requirements to the instrument that are more stringent than Class C (or Class D, as appropriate for each proposal) are needed, these requirements must be clearly described in the proposal.

4.5.5 End-of Mission Spacecraft Disposal

Section 5.3.10 of the SALMON-2 AO discusses the requirements related to end-of-mission spacecraft disposal for Partner Missions of Opportunity and hosted payloads where the PI is not responsible for the host mission. For instrument investigation proposals, information shall be included regarding the instrument's plan for passivation at the end of operations or in preparation for end-of-mission disposal. In addition, information shall be provided identifying system components expected to survive Earth reentry as the postmission disposal method. This will allow NASA to remain in compliance with NPR 8715.6A, *NASA Procedural Requirements for Limiting Orbital Debris*, and NASA-STD-8719.14, *Process for Limiting Orbital Debris*.

Requirement M-19. Instrument investigation proposals shall describe the instrument's passivation plans at end-of-mission and identify components anticipated to survive Earth reentry. This supersedes Requirement 39 in the SALMON-2 AO for instrument investigation proposals. However, requirement 39 shall be met for CubeSat proposals.

4.5.6 NASA Earth Science Data Policy

4.5.6.1 Data Analysis

The PI will be responsible for analysis of the mission data necessary to achieve the proposed science objectives, for publicly distributing all data collected by the instrument(s) and produced by the investigation prime measurement phase, for archiving the data in the NASA selected DAAC for public use, and for timely publication of initial scientific data in refereed scientific journals, as part of their mission operations (Phase E) or postmission activities. Science studies with the archived data sets beyond the science investigations proposed by PI-led team will be solicited and selected by NASA in subsequent NASA solicitations through the Research Opportunities in Space and Earth Sciences (ROSES) NASA Research Announcement.

Requirement M-20. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final on-orbit calibration and validation of the measurements.

Requirement M-21. Proposals shall clearly present a plan for analysis of the mission data leading to completion of the proposed science investigation and achieving the identified investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.5.6.2 *Data Rights*

By NASA policy, all science data returned from NASA missions are made available immediately in the public domain. Following a postflight checkout period, all data will be made available to the user community. There shall be no period of exclusive access. The principal investigator shall propose and justify the data product latency period for standard products listed in the proposal, based primarily on the time required to produce, quality-check, and validate the products. Barring exceptional circumstances, data product latency may not exceed six months.

Requirement M-22. Proposals shall include a clear commitment to minimizing the latency for data products. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.5.6.3 *Delivery of Data to Archive*

During Phase A, NASA will assign a data center, e.g., one of the Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAACs), to be the data archive for the selected mission; proposals should not be tailored to one specific data center. Information on EOSDIS and the DAACs is available at <http://esdis.eosdis.nasa.gov/eosdis/overview.html> and <http://esdis.eosdis.nasa.gov/dataaccess/datacenters.html>.

Mission data will be made fully available to the public by the investigator team in usable form, in the minimum time necessary and, barring exceptional circumstances, within six months following its collection. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to making it fully available. By no later than the investigation closeout, the investigation will deliver to the NASA-assigned data center all data products, along with the scientific algorithm software, coefficients, ancillary data used to generate these products, and the algorithm and calibration documentation.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in-flight), documentation, related software, and/or other tools or parameters that are necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of the assigned NASA data archive. For information on NASA Earth Science data policy, nomenclature, standards, and EOSDIS, see <http://science.nasa.gov/earth-science/earth-science-data/>. Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the capped PI-Managed Mission Cost.

Requirement M-23. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, distribution, and archiving shall be described. The science products (e.g., flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.)

shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the formats and standards to be used, selected from the published list of approved NASA Earth Science Data System Standards (<http://earthdata.nasa.gov/our-community/esdswg/standards-process-spg/rfc>). It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community. The plan shall conform to the NASA Earth Science Data and Information Policy (see <http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/>). This supersedes Requirement B-21 in Appendix B of the SALMON-2 AO

4.6 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are specified in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.4.1.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirement and constraints for that specific solicitation, including the sponsoring NASA Headquarters (HQ) mission directorate and division, the type of MO, the cost cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2, the cost cap is specified in Section 4.4.1, and the schedule constraint is specified in Section 4.4.2.
- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. The NASA Center for program office is specified in Section 2.3. There is no program-specific safety, reliability, and quality assurance document.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the payload risk classifications are specified in Section 4.5.4.
- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation in this solicitation. For this PEA, those limitations are specified in Section 4.1
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Mission Cost, the Total Mission Cost, and the Enhanced Mission Cost. For this PEA, that information is specified in Section 4.4.1.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.4.1 and 4.4.2.

- Section 4.6 of the SALMON-2 AO states that each PEA will identify any NASA-provided launch services. For this PEA, NASA plans for access to space are discussed in Section 2.2 and 4.5.1.
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Section 3 that evaluation and selection will be done using a single step selection process; no competitive Phase A (Step 2) or down selection is planned.
- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an E/PO program that is consistent with SMD policy is required. This PEA states that an E/PO program is not required, pending further NASA guidance for E/PO policy, and Requirements 68, 69, and 70 of the SALMON-2 AO do not apply to this PEA. Proposals should not include an E/PO plan or budget. NASA reserves the right to request an E/PO program from the selected investigation(s) at 1% of the proposed PI managed budget, and outside the PI managed budget, pending further guidance on E/PO policy.
- Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA.
- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by SMD and it does not permit contributions of funding from SMD programs other than the funding offered through this PEA.
- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection Official. This PEA identifies the Selection Official in Section 6.2.

4.7 Exceptions to General SALMON-2 Requirements

This PEA contains the following exceptions to the SALMON-2 proposal preparation and submission requirements described in the SALMON-2 AO.

- Proposals or portions of proposals requesting NASA funding shall report proposal costs in Fiscal Year 2016 dollars as well in Real Year (RY) dollars. The former is for determining compliance with the PI-Managed Mission Cost cap requirement. The latter is for NASA SMD budget planning. This instruction supersedes the request for costs only in RY dollars described in Appendix B of the SALMON-2 AO including Table B-3. A modified template of Table B-3 will be available on the EVI-2 library.
- Requirement M-15 in Section 4.5.1 of this PEA requires the inclusion of a table in the proposal document. As noted in the requirement, this table does not count against the page limits specified in Appendix B of the SALMON-2 AO.
- Section 4.5.6 of this PEA provides data policies and supersedes Section 4.4 of the SALMON-2 AO.
- Proposals shall not include a plan or a budget for science-exploration-technology enhancement options (SEOs); this supersedes Section 5.2.5 of the SALMON-2 AO.
- Section 4.5.5 provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO.

- Requirement 54 of the SALMON-2 AO limiting incurred costs to no more than 25% of proposed costs by Phase C is waived in order to be consistent with NPR 7120.5E.

5 PROPOSAL PREPARATION AND SUBMISSION

5.1 Proposal Content Requirements

Requirement M-24. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO.

Below, requirements B-15, B-23 and B-24 of Appendix B of the SALMON-2 AO are clarified for this solicitation. All references to “instruments” in this section also apply to CubeSats.

The requirement M-25 clarifies the information requested on the traceability of the proposed investigation, e.g., instrument performance requirements and projected performance estimates. This also clarifies instrument performance margins. A modified template is available on the EVI-2 Library to assist proposers on presentation of the investigation traceability.

Requirement M-25. Traceability from science goals to measurement requirements to instrument functional and performance requirements and to top-level mission requirements shall be provided in tabular form and supported by narrative discussion. Instrument projected performance shall be compared to the instrument (or CubeSat) performance requirements.

Requirement M-25 supersedes Requirement B-15 of the SALMON-2 AO.

Requirements M-26 and M-27 clarify the information requested on instrument resource and performance margins.

Requirement M-26. Instrument Contingencies and Margins: This section shall summarize contingencies and margins of all instrument resources. At a minimum, it shall provide estimates of implementation design margins with respect to the required performance or allocations for the following: Mass, Power, Data Storage, and any other resource requirements. For proposals for more than one instrument, the mass, telemetry, and power and reserves and margins must be identified separately for all the necessary components of each instrument in case only an individual instrument is selected from the proposed suite (see SALMON-2 AO for definitions of contingency and margin). Discuss the allocation of contingency and margin to the instrument and/or suite.

Requirement M-27. Performance Margins: For the instrument performance, this section shall provide estimates of performance margin with respect to the performance requirements.

Requirement M-26 and M-27 supersedes requirements B-23 and B-24 of the SALMON-2 AO.

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA evaluators.

5.2 Proposal Submission Requirements

Requirement M-28. Proposals must be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only.

Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement M-29. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

The proposal evaluation process requires evaluators free of Conflict of Interest. In order to assist NASA in the planning of the proposal evaluation process, NASA requires a comprehensive list of proposed investigation participants.

Requirement M-30. With the proposal submission via NSPIRES, the proposers shall identify any institution that is specified in the proposal but that does not appear in either the "Team Member" section (Section VI) of the cover page or in answer to the question about "participants [...] who do not appear on the proposal's cover page". The proposer shall list the institution and division name, role (e.g., solar array provider, instrument component provider), and estimated fixed year dollars to be received. This information will be used to avoid financial and organizational conflicts of interest during the evaluation process by checking evaluators against institutions that are proposed to supply materials, parts, or services.

5.3 Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this appendix, or in the documents available through the EVI-2 Library, should be sent to the E-mail address for the point of contact that is listed in Section 7 of this PEA. When appropriate, responses will be posted on the website also listed in Section 7 of this PEA.

The deadline for receipt of questions is two weeks before the proposal due date listed in Section 7 of this PEA.

6 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

In addition to the evaluation factors given in Section 7.2 of the SALMON-2 AO, the evaluation of scientific merit also includes the following factor:

- Factor A-2, programmatic value of the proposed investigation, also includes the extent to which the proposed science investigation addresses unique science areas that are not being addressed by other missions (both NASA and non-NASA missions) expected to be in operation 5 to 10 years from the start of the proposed investigation.

In addition to the evaluation factors given in Section 7.2 of the SALMON-2 AO, the evaluation of technical implementation merit also includes the following factors:

- Factor B-2, probability of technical success, also includes the maturity of the design or the demonstration of a clear path to achieve the necessary maturity.
- Factor B-3, merit of the data and/or sample analysis plan, also includes the quality of the plans for calibration and data archiving, including development of a data pipeline.

The panel evaluating the third evaluation criterion; technical, management, and cost (TMC) feasibility of the proposed investigation, including cost risk, will also provide comments to NASA regarding the extent to which the proposed instrument is compatible with potential satellite platform interfaces and operations. These comments will not contribute to the TMC feasibility risk rating.

After the evaluation, but prior to the selection decision, NASA will perform an accommodation study of selectable proposals to assess the extent to which the proposed instrument is compatible with potential satellite platform interfaces and operations.

6.2 Selection Process

After the review by the AO Steering Committee, the final evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the selection(s). As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency, including the Director of the Earth Science Division, concerning the selections.

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among selectable proposals, including, but not limited to, planning and policy considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the mission directorate(s). For this EVI selection,

these factors also include the likelihood that the proposed instrument can be accommodated on a NASA-selected platform in the near future.

6.3 Implementation Activities

Proposal selection and award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO and Section 7 of this PEA with the following amendments.

6.3.1 Award Administration and Funding of Investigations

Oversight management responsibilities have been assigned to the Earth System Science Pathfinder Program Office (ESSP PO) at the NASA Langley Research Center. The responsibilities of the ESSP PO will include oversight of science instrument development; coordination of Government-furnished services, equipment and facilities, coordination of the selected team with potential platforms for integration; and contract management for selected investigations.

The ESSP PO will authorize the release of funding to each selected investigation. The initiation of the investigation's award of the contract will take place as soon as possible after notification of selection. In order for contracts to be awarded, Statements of Work (SOWs), updated cost and pricing data are required. For reference, a SOW template is available in the EVI-2 Library. If more than one contractual arrangement between NASA and the proposing team is required, separate SOWs, updated cost, and pricing data are required for each contractual arrangement. NASA Centers will receive funding via intraagency funding mechanisms.

Proposals are not required to include SOWs and cost and pricing data. These will be required only for investigations that are selected for award. For those investigations that are selected, it will be in the best interest of the PI-led mission management teams to provide updated SOWs, cost and pricing data, and small business subcontracting plans in as timely a manner as possible. The process of awarding contracts cannot begin until final SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed. For each selection, and unless otherwise stated in the selection letter, the selected investigation's cost cap will be set at the proposal's proposed cost.

SOWs will be required for selected investigations, regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). For contracts that exceed \$700K, the contractor will be required to provide cost and pricing data to support the cost estimate and to certify the cost proposed for the contract in accordance with FAR 15.403-4.

NASA Centers shall follow their standard operation procedure for selecting teaming partners to facilitate the rapid implementation of their proposal, if selected, and this shall be documented in Appendix 6 of the proposal (see Appendix B, Section J.6, of the SALMON-2 AO).

6.3.2 *International Agreements*

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, NASA's Office of International and Interagency Relations, Science Division, will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency MOU.

7 SUMMARY OF KEY INFORMATION

Funding available	See Section 4.4.1 of this PEA
Release Date	August 7, 2013
Date for Preproposal Workshop	August 27 2013 via Webex; see the EVI-2 PEA additional information page at http://essp.larc.nasa.gov/EVI-2/ for time, agenda, and logistical information
Due Date for NOI (notice of intent to propose, required for this solicitation)	11:59 p.m. Eastern Time on September 10, 2013
Due Date for Proposals	11:59 p.m. Eastern Time on November 7, 2013 November 25, 2013 [amended October 21, 2013]
Web site for additional information for the EVI-2 PEA	http://essp.larc.nasa.gov/EVI-2/
Library for the EVI-2 PEA	http://essp.larc.nasa.gov/EVI-2/evi-2_library.html
Submission Medium	Electronic copies only; see Section 5.2 of this PEA
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)
NASA point of contact	Dr. Kenneth Jucks Earth Venture Instrument-2 Program Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-0476 E-mail: kenneth.w.jucks@nasa.gov

END OF PEA M

NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)
NNH12ZDA0060-APEXMO2
PROGRAM ELEMENT APPENDIX (PEA) N:
ASTROPHYSICS EXPLORER MISSION OF OPPORTUNITY

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PROGRAM ELEMENT APPENDIX (PEA) N:
ASTROPHYSICS EXPLORER MISSION OF OPPORTUNITY

1 BACKGROUND

1.1 Programmatic Overview

The National Aeronautics and Space Administration (NASA) issues this Second Stand Alone Missions of Opportunity Notice (SALMON-2) Program Element Appendix (PEA) for the purpose of soliciting proposals for Astrophysics Mission of Opportunity (MO) science investigations to be implemented through its Explorers Program.

Three Mission of Opportunity types may be proposed in response to this PEA: (1) Partner Missions of Opportunity (PMOs), (2) New Missions using Existing Spacecraft (NMESs), and (3) Small Complete Missions (SCMs). SCMs include investigations on the International Space Station (ISS), suborbital-class missions (investigations requiring flight on high-altitude scientific balloon platforms, on suborbital Reusable Launch Vehicles (sRLVs), or using CubeSats – see Section 4.4.1 and Requirement N-6), investigations launched as secondary payloads, or investigations launched as hosted payloads. A fourth type of investigation, U.S. Participating Investigators (USPIs), may be proposed in response to Appendix D.12, Astrophysics Explorer U.S. Participating Investigators, of the NASA Research Announcement, Research Opportunities in Space and Earth Sciences 2014 (ROSES-2014), which is being released simultaneously with this PEA.

Investigations may target any astrophysics scientific investigation that advances the objectives outlined in Section 2.1 of this PEA. Investigations that address NASA goals in other areas, such as heliophysics, Earth science, or planetary science, are not solicited.

1.2 Explorers Program Background

The Explorers Program is the oldest continuous program in NASA. It is comprised of a longstanding series of space science missions that are independent, but share a common funding and NASA oversight/insight management structure. Initiated with the Explorer 1 launch in 1958 and including the Nobel Prize recognized Cosmic Background Explorer (COBE) mission, the Explorers Program has launched over 90 missions.

Though historically not always this way, the program currently administers only Principal Investigator (PI)-led science investigations for the Heliophysics and Astrophysics Divisions of NASA's Science Mission Directorate (SMD). Competitive selection by peer review ensures that the best and most current science affordable within the cost cap will be accomplished.

Since the early 1990s, the Explorers Program has provided several types of flight opportunities for addressing astrophysics science objectives. These mission types are defined by their cost caps

and are designed to increase the number of flight opportunities in response to recommendations from the scientific community. The Explorers Program currently consists of two types: larger stand-alone “full missions,” for which NASA offers a dedicated launch vehicle, and smaller investigations called “missions of opportunity.”

An Explorer MO is an investigation generally characterized by being part of a host space mission other than a strategic SMD mission, or by being a small complete mission with its own identified access to space, or by being a new science investigation utilizing an existing operating spacecraft that has completed its prime mission. For each Explorer AO, full mission or MO, the budget available varies, as do the types of investigations that may be proposed.

Explorer MOs are solicited through the SALMON-2 AO (NNH12ZDA006O) by amending it with a specific Program Element Appendix. This solicitation for Astrophysics Explorer Mission of Opportunity is one such PEA.

1.3 Overview of this Program Element Appendix

The SALMON-2 AO is an omnibus solicitation that provides the overall structure, guidelines and requirements for several types of MO solicitations. Each new opportunity is announced through a PEA that details the solicitation and may include additional guidelines and requirements. This document is one such PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/> or at <http://go.nasa.gov/SALMON2-AO>.

NASA issues this PEA as an appendix of the SALMON-2 AO for the purpose of soliciting proposals for Astrophysics Explorer MO investigations to be managed under the NASA Explorers Program. All investigations proposed in response to this solicitation must support NASA’s astrophysics science goals (Section 2.1 of this PEA) and the goals and objectives of the Explorers Program (Section 2.2 of this PEA), must be implemented by Principal Investigator (PI)-led investigation teams (Sections 4.2.4 and 5.4.1 of the SALMON-2 AO), and must result in the provision of complete space investigations (Section 5.3.2 of the SALMON-2 AO).

Proposals submitted in response to this PEA will be selected for flight nominally through a two-step competitive process. Proposals submitted in response to this PEA will undergo the first step evaluation. As the outcome of the first step evaluation, NASA intends to fund one or more MO investigations to proceed to an 11 month Phase A concept study. In the second step, NASA will conduct an evaluation of the Phase A concept study reports. From this evaluation, NASA expects to select up to two MOs to proceed into Phase B and subsequent mission phases.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO contains additional requirements on the format and content of the proposals. Documents available through the Astrophysics Explorer Mission of Opportunity Program Library at <http://explorers.larc.nasa.gov/APSMEX/MO/programlibrary.html> (hereafter referred to as the Program Library) are intended to provide guidance for investigations selected; they are specifically not intended to impose requirements on proposals.

1.4 NASA Online Document Information System

NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents are available through the NASA On-line Document Information System (NODIS) at <http://nodis3.gsfc.nasa.gov/>.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 NASA Astrophysics Science Objective and Goals

One of NASA's strategic objectives is to discover how the universe works, explore how it began and evolved, and search for life on planets around other stars. Further information on NASA's strategic goals may be found in NASA Policy Directive (NPD) 1001.0B, *NASA 2014 Strategic Plan*, available through the Program Library (Appendix D).

NASA SMD addresses this strategic objective by conducting astrophysics investigations designed to address the following science goals:

- Probe the origin and destiny of our universe, including the nature of black holes, dark energy, dark matter and gravity;
- Explore the origin and evolution of the galaxies, stars and planets that make up our universe;
- Discover and study planets around other stars, and explore whether they could harbor life.

Further information on the goals and objectives of NASA's Astrophysics programs may be found in the *NASA 2014 Science Plan* and in *Enduring Quests Daring Visions, NASA Astrophysics in the Next Three Decades*, available through the Program Library.

2.2 Explorers Program Goals and Objectives

The goal of NASA's Explorers Program is to provide frequent flight opportunities for high quality, high value, focused astrophysics science investigations that can be accomplished under a not-to-exceed cost cap and that can be developed relatively quickly, generally in 36 months or less, and executed on-orbit in less than three years.

The Explorers Program accomplishes these world-class space science investigations utilizing efficient management approaches to contain mission cost through commitment to, and control of, design, development, and operations costs. The Program also seeks to enhance public awareness of and appreciation for space science by incorporating educational and public outreach activities as integral parts of the investigations.

The Explorers Program provides an effective means of timely achievement of strategic goals. By conducting a rapid series of science investigations, NASA is responsive to new knowledge, technology, and science priorities. Pressing questions in astrophysics science are addressed, permitting a steady improvement in our understanding of astronomical systems and the processes that affect them. The frequent, steady nature of the investigations ensures a continuing stream of fresh scientific data to the broader science community, thus maintaining the excellence of the U.S. space science program and the inspiration of a new generation of investigators.

The Explorers Program strives to:

- advance scientific knowledge of astrophysics processes and systems;
- add scientific data and other knowledge-based products to data archives for all scientists to access;
- lead to scientific progress and the publishing of results in the peer-reviewed literature to encourage, to the maximum extent possible, the fullest commercial use of the knowledge gained;
- implement technology advancements prepared in related programs; and
- announce scientific progress and results in popular media, scholastic curricula, and materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

2.3 NASA Management of the Explorers Program

The selected investigation(s) will be managed by the Explorers Program. The Associate Administrator for SMD has established the Explorers Program Office at the NASA Goddard Space Flight Center (GSFC) to be responsible for project oversight. The Explorers Program Manager at NASA GSFC reports to the Astrophysics Division Deputy Director at NASA Headquarters. Additional details about the program office staffing, structure, and goals can be found in the *Explorers Program Plan*, available through the Program Library. There are appropriate protective firewalls between the Explorers Program Office and the rest of NASA GSFC, allowing investigators from GSFC to propose in response to this PEA. The Explorers Program Office will manage the Astrophysics Explorer Mission of Opportunity investigations under the requirements of NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, as described in Section 4.1.2 of the SALMON-2 AO. Safety, reliability, and mission assurance requirements for Astrophysics Explorer Mission of Opportunity investigations will be consistent with the *Standard Mission Assurance Requirements* document found in the Program Library.

All references to NPR 7120.5D NID in SALMON-2 should be interpreted as referencing NPR 7120.5E.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

The following schedule applies to this PEA.

- A Preproposal Workshop will take place in association with this solicitation. Further information will be available at the Astrophysics Explorer Mission of Opportunity Acquisition website (<http://explorers.larc.nasa.gov/APSMEX/MO/index.html>) prior to the Preproposal Workshop.
- Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA. The period for questions will close two weeks before the proposal due date.
- A Notice of Intent (NOI) to propose to this announcement is extremely valuable to NASA for purposes of planning the proposal evaluation and peer reviews, and, therefore, is strongly encouraged. NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Section 6.1.2 of the SALMON-2 AO provides information on electronic NOI submission through NSPIRES.

- All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.
- Evaluation and selection for flight will be done using a two-step selection process.
- NASA funded Phase A activities will be conducted by the investigation team(s) selected as a result of the first step of this solicitation.
- NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four weeks following receipt of the Statement of Work, as set forth in Section 6.3.2 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Participate in this Proposal Opportunity

Refer to Section 4.2 of the SALMON-2 AO for the policies on participation policy. For this particular PEA, NASA will place full or partial limitations (as described in the SALMON-2 AO) on organizations that will be involved in the evaluation process. Cornell Technical Services LLC is subject to the “Full Limitation” as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on the Aerospace Corporation.

4.2 Types of Mission of Opportunity

Three Mission of Opportunity types may be proposed in response to this solicitation: (1) Partner Missions of Opportunity (PMOs), (2) New Missions using Existing Spacecraft (NMESs), and (3) Small Complete Missions (SCMs). SCMs include investigations on the International Space Station (ISS), suborbital-class missions (investigations requiring flight on high-altitude scientific balloon platforms, on suborbital Reusable Launch Vehicles (sRLVs), or using CubeSats), investigations launched as secondary payloads, or investigations launched as hosted payloads. See Section 5.1 of the SALMON-2 AO for complete descriptions of these types of MOs as well as constraints and requirements for proposals.

A fourth type of investigation, U.S. Participating Investigators (USPIs), may be proposed in response to ROSES-14 Appendix D.12. A USPI proposes to participate as a Co-I for an instrument, experiment, or technology demonstration that is being built and flown by a sponsor agency other than NASA. NASA has released simultaneously with this PEA a solicitation for Astrophysics Explorer U.S. Participating Investigators through the ROSES-2014 NASA Research Announcement (NRA) (NNH14ZDA001N). The Explorer USPI program element appendix of the ROSES NRA is available at <http://nspires.nasaprs.com/> or at <http://go.nasa.gov/ROSES14>. USPI proposals submitted to that solicitation will be due at the same time as the Astrophysics Explorer MOs. USPI NOIs and proposals will be submitted in response to the ROSES-2014 amendment, will be subject to the proposal guidelines specified in ROSES-2014, will be subject to the constraints (cost, schedule, technical) and requirements specified in ROSES-2014, and will be reviewed and selected using the proposal criteria specified in ROSES-2014.

4.3 Science Requirements and Constraints

The science objectives are described in Section 2 of this PEA. Any appropriate science question relevant to NASA's astrophysics objectives and goals may be addressed with the proposed investigations. Section 2 of this PEA provides the basis for the evaluation of intrinsic science merit as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside astrophysics science objectives, as described in Section 2 of this PEA, are not solicited.

Requirement N-1. Proposals shall address appropriate science questions relevant to the NASA astrophysics science objectives and goals described in Section 2 of this PEA.

Requirements for documentation in the proposal of the flow-down of requirements from the proposed science goals and objectives are described in Section 5.2.2 of the SALMON-2 AO.

Requirement N-2. Each proposal shall clearly define its science question or questions, shall demonstrate how the science questions map into high-level science requirements, and shall show how the science requirements subsequently map into measurement, data, instrument, and mission requirements.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement N-3. Each proposal shall clearly state the baseline and threshold requirements for the mission and the baseline and threshold mission lifetime.

NASA expects each proposal to fully describe the requirements for calibration and validation of the instruments and the data returned. Other data policies and requirements are given in Section 4.4 of the SALMON-2 AO and Section 4.5.6 of this PEA.

Requirement N-4. Each proposal shall fully describe the requirements for calibration and validation of the instruments and the data returned.

4.4 Cost and Schedule Requirements and Constraints

4.4.1 Cost Requirements and Constraints

The PI-Managed Mission Cost is defined in Section 4.3.1 of the SALMON-2 AO. Except for suborbital-class missions (high-altitude scientific balloon missions, missions on sRLVs, and CubeSats), the PI-managed Mission Cost cap for an Astrophysics Explorer Mission of Opportunity, including all mission phases and the cost of accommodation on and/or delivery to the host mission, if applicable, is \$65 million in Fiscal Year (FY) 2015 dollars. The PI-managed Mission Cost cap is \$35 million in FY 2015 dollars for suborbital-class missions.

NASA expects to select one or two Astrophysics Explorer Missions of Opportunity. If multiple selectable missions are proposed with combined costs within the available funding, anticipated to be approximately \$65 million, NASA may select more than one proposed investigation.

Requirement N-5. Proposals shall be for complete investigations including Phases A-F.

Requirement N-6. The proposed PI-Managed Mission Cost for the Astrophysics Explorer Missions of Opportunity shall be no more than \$65 million in FY 2015 dollars, except for suborbital-class missions (defined as (a) high-altitude scientific balloon missions, (b) missions on sRLVs, and (c) CubeSats), for which it shall be no more than \$35 million in FY 2015 dollars.

Requirement N-7. Proposals shall include detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Mission Cost.

4.4.2 Schedule Requirements and Constraints

For Partner MOs, the proposing PI must provide evidence that the sponsoring organization intends to fund the primary host mission and that the NASA commitment for U.S. participation is required by the sponsoring organization prior to December 31, 2018. The launch date itself for a Partner MO is not constrained.

For Small Complete Mission (SCM) MOs, proposers must specify the launch date in the proposal, which is to be no later than December 31, 2020. Explorer SCM MO investigations with an anticipated launch date requirement later than the end of calendar year 2020 should be proposed in response to a subsequent opportunity.

Proposers should be aware that it may be necessary for NASA to adjust the launch date and definition phasing of selected investigations from that proposed in order to conform to the available Explorers Program budget profile and/or NASA's ability to negotiate a launch opportunity to the International Space Station, for a high-altitude scientific balloon mission, for launch opportunities on reusable launch vehicles, or for CubeSat launches; therefore, the degree of launch date flexibility must be indicated in the proposal.

It is intended that proposed investigations be evaluated and selected through a two-step competitive process. Step 1 is the solicitation, submission, evaluation, and selection of proposals prepared in response to this PEA. The Step 1 evaluation and selection process is described in section 7 of the SALMON-2 AO. As the outcome of Step 1, one or more Step 1 proposals may be selected for Phase A study and evaluation if their perceived value to the Explorers Program is significant. NASA will issue awards (provide funding to NASA Centers and the Jet Propulsion Laboratory (JPL), award contracts to non-NASA institutions, or utilize other funding mechanisms, as applicable) to the selected proposers to conduct Phase A concept studies and submit Concept Study Reports to NASA. Step 2 is the preparation, submission, evaluation, and continuation decision (downselection) of the Concept Study Reports. As the outcome of Step 2, NASA may continue one or more investigations into the subsequent phases of mission development for flight and operations.

Proposers selected through this AO will be awarded a contract to conduct a Phase A concept study with duration of approximately 11 months and capped at \$250,000 Real Year (RY) dollars.

A proposal may be selected for development without first completing a Phase A concept study. The proposal must make the case that it is not only necessary, but also that it is also technically feasible for the project to be selected for development without a competitive Phase A concept study. The proposer must recognize that NASA would only make such a decision without a Phase A competition if the MO proposal were especially compelling.

Requirement N-8. Proposals shall include a detailed development schedule (including integration plans) and an associated planning budget that for a SCM secures the launch before December 31, 2020, or for PMOs and NMESs is consistent with the documented launch and operations schedule of the primary host mission.

4.4.3 Access to Space Cost Requirements

The following classes of platforms are provided by NASA for access to space, or near space, at no cost to the PI-managed Mission Cost (see Section 4.5.3 of this PEA for additional information).

- Access to space will be provided by NASA for missions on the International Space Station (ISS).
- NASA will provide balloon vehicles and balloon launch services for missions on high-altitude scientific balloons.
- Platforms are provided by NASA to host payloads on sRLVs.
- NASA will provide launch and deployment services for missions on CubeSats.

For all other proposals, including small complete missions launched as secondary or hosted payloads, any costs for access to space must be included in the PI-managed Mission Cost.

Requirement N-9. With the exception of small complete missions to the International Space Station or suborbital-class missions, any costs for access to space must be included in the PI-managed Mission Cost.

4.4.4 Full Cost Accounting for NASA Facilities and Personnel

This Section supersedes Section 5.5.5 of the SALMON-2 AO.

For the purpose of calculating the full cost of NASA-provided services, proposal budgets from NASA Centers, whether as the proposing organization or as a supporting organization, are to include within the PI-Managed Mission Cost all costs normally funded by an SMD Project under NASA's full cost accounting practices, including civil servant labor (salaries and benefits), civil service travel, and procurements. All of these costs must be clearly identified by year within the budget justification section of the proposal.

Estimated NASA Center Management and Operations (CM&O) overhead costs must also be included within the cost cap, to enable a level playing field for all proposers. Per HQ policy guidance signed in June 2010 by the Associate Administrator, Mission Support Directorate and by the Agency Chief Financial Officer, all Centers shall use an identical CM&O burden rate of \$43K (RY) per "equivalent head." For years after FY2015, this number must be inflated. Per Agency policy, this rate must be applied as a "cost per equivalent head" to all Civil Service FTEs plus on/near site contractor WYEs associated with the proposal. The estimated FTEs and WYEs

per fiscal year, and the resulting CM&O burden, must be identified in a separate table within the budget justification section of the proposal.

The CM&O burden costs must be clearly denoted in all budget tables. These costs may not be included or rolled into any other budget lines in such a way that they become unidentifiable.

Do not include within the cost proposal, or within the PI-Managed Mission Cost, any estimate for Agency Management and Operations (AM&O, a.k.a. NASA Headquarters overhead).

Table 1: Cost Elements for NASA Center Budget Proposals in response to SMD AOs

	Identify in proposal?	Include in PI-managed mission cost?	Funding source	Comments
Civil Service Labor	Yes	Yes	SMD Program	Includes salaries and benefits
Civil Service Travel	Yes	Yes	SMD Program	
Other Direct/Procurements	Yes	Yes	SMD Program	Includes procurements as typically identified by flight projects in the NASA N2 budget database
CM&O	Yes	Yes	CASP	Applied to NASA provided labor, including Center civil servants and on-site contractors
AM&O	No	No	CASP	
NASA Contributed Costs	Yes	No	Identify	Must be non-SMD
Non-NASA Federal Government (funding requested from NASA)	Yes	Yes	SMD Program	If NASA funding is requested for the non-NASA Federal Government agency
Contributions	Yes	No	Identify	Includes all non-NASA contributions

Requirement N-10. Proposals including costs for NASA Centers shall conform to the full cost policy stated in this Section. Each of the elements of the NASA Center costs (direct labor, travel, procurements) shall be separately identified by year.

If any NASA funded item(s) or services are to be considered as contributed costs, then the contributed item(s) must be separately funded by a non-SMD effort complementary to the proposed investigation, the value of the contribution(s) must be estimated, and the funding source(s) must be identified.

Requirement N-11. If any NASA funded item(s) or services are considered as contributed costs, then the proposal shall estimate the value of the contribution(s) and shall identify the funding source(s).

Any non-NASA Federal Government costs must follow the appropriate agency accounting standards for full cost. If no standards are in effect, the proposers must follow the *Managerial Cost Accounting Concepts and Standards for the Federal Government*, as recommended by the Federal Accounting Standards Advisory Board and available in the Program Library.

Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

4.5 Technical Requirements and Constraints

4.5.1 New Technologies/Advanced Engineering Development

This Section intends to clarify the requirement for New Technologies and/or Advanced Engineering Developments and supersedes Section 5.3.4 of the SALMON-2 AO.

This PEA solicits PMOs, NMESs, and SCMs for flight missions, not technology or advanced engineering development projects. Proposed investigations are generally expected to have mature technologies, with systems at a Technology Readiness Level (TRL) of 6 or higher. For the purpose of TRL assessment, systems are defined as level 3 WBS payload developments (i.e., individual instruments) and level 3 WBS spacecraft elements (e.g., electrical power system); see Figure 3-7 of the *NASA WBS Handbook*, NASA/SP-2010-3404, which can be found in the Program Library. TRLs are defined in NPR 7123.1B *NASA Systems Engineering Processes and Requirements*, Appendix E, which can be found in the Program Library.

Proposals with a limited number of less mature technologies and/or advanced engineering developments are permitted as long as they contain a plan for maturing systems to TRL 6 (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*) by no later than Preliminary Design Review (PDR) and adequate backup plans that will provide mitigation in the event that the systems cannot be matured as planned. The TRL state of systems will be validated by an independent team at PDR.

Requirement N-12. Proposals that use systems currently at less than TRL 6 shall include a plan for system maturation to TRL 6 by no later than PDR and a backup plan in the event that the proposed systems cannot be matured as planned (see Section 5.1 of this PEA, for additional detail).

4.5.2 Additional Requirements for Partner Mission of Opportunity Investigations

The following requirements are in addition to those given in Section 5.1.1 of the SALMON-2 AO.

Requirement N-13. In addition to the requirements given in the SALMON-2 AO, all proposed PMO investigations must also demonstrate: (1) their formal relationship with the sponsoring agency's host mission (e.g., already selected contribution, invited

contribution, or proposed contribution); and (2) the status of the host mission within the sponsoring agency (i.e., Pre-Phase A, Phase A, or Phase B), including the level of commitment that the sponsoring agency has made to complete the mission.

Requirement N-14. In addition to the requirements given in the SALMON-2 AO, all proposed PMO investigations requiring flight on the ISS must also provide a Letter of Acknowledgement from the NASA Space Station Payload Office. This Letter of Acknowledgement must contain: (1) a description of the formal relationship with the sponsoring agency's host mission for access and accommodation at the space station, (2) identification of known challenges and/or conditional provisions for access or accommodation of the host mission, and (3) a description of the level of technical interchange and negotiation required to mature the host mission's provisions for access and accommodation.

PMOs may be proposed for participation in nonstrategic NASA missions. A PMO may be proposed for participation in a PI-led NASA mission from a program other than Explorer (an Explorer MO may not be proposed for an Explorer mission).

Requirement N-15. A proposal for a PMO hosted by a PI-led mission from a program other than the Explorers Program must satisfy the following requirements: (1) The proposal must include a Letter of Commitment from the PI of the host mission endorsing the partnership and (2) the feasibility assessment of the host mission, i.e., the technical, management, and cost (TMC) evaluation in Step 1 and Step 2, must include the accommodations for the proposed PMO instrument.

4.5.3 Additional Requirements for Small Complete Mission of Opportunity Investigations

The following requirements are in addition to those given in Section 5.1.3 of the SALMON-2 AO.

Requirement N-16. In addition to the requirements given in the SALMON-2 AO, all proposed SCM investigations, with the exception of investigations requiring flight on the ISS or suborbital-class missions, must also provide a Letter of Commitment from the program or agency providing access to space. This Letter of Commitment must contain: (1) a detailed description of the proposed provisions for access to space (e. g., launch to orbit provided by industrial or non-U.S. partner, secondary ride on another U.S. sponsored mission, etc.), and (2) the status of those proposed flight provisions within the sponsoring program or agency (i.e., conditional, confirmed, conceptual, etc.) including the level of commitment that the sponsoring program/agency has made to support that flight opportunity.

4.5.3.1 Investigations Hosted on the ISS

SCMs may be proposed for the ISS. Investigations requiring flight on the ISS must provide a Letter of Feasibility from the NASA Space Station Payloads Office.

Requirement N-17. In addition to the requirements given in the SALMON-2 AO, all SCM investigations requiring flight on the ISS must also provide a Letter of Feasibility from

the NASA Space Station Payload Office demonstrating that the proposed payload to be flown aboard the ISS can meet the access and accommodation requirements for ISS payloads. This Letter of Feasibility must contain: (1) a preliminary assessment of the feasibility of proposed provisions for access to and accommodation on the ISS, (2) identification of known challenges and/or conditional provisions for access or accommodation, and (3) a description of the level of technical interchange and negotiation required to mature the proposed provisions for access and accommodation.

Proposers requiring an ISS Letter of Feasibility should contact:

Sharon C. Conover
ISS Research Integration Office/Mail Stop OZ
Johnson Space Center
National Aeronautics and Space Administration
Houston, TX 77058
Telephone: 281-244-8518
E-mail: sharon.c.conover@nasa.gov

Additional information is found through the International Space Station Capabilities and Payload Accommodations Document link in the Program Library. For any selected investigations, flight commitment to the ISS will be negotiated with NASA's Human Exploration and Operations Mission Directorate during Phase A. Selection of any investigation to be flown aboard the ISS is conditional until negotiations for ISS access and accommodation are successfully completed.

An Astrophysics Explorer MO investigation that is a SCM to the International Space Station should plan to complete its primary mission investigations by the end of FY 2024. NASA currently plans to operate ISS thru FY 2024, and while the agency is taking no action that would preclude operation beyond FY 2024, no commitment has yet been made either way.

4.5.3.2 Investigations on High-Altitude Scientific Balloons

SCMs may be proposed for flight on high-altitude scientific balloons. SCMs on high-altitude scientific balloons must be proposed for flight on Long Duration Balloons (LDBs) or Ultra Long Duration Balloons (ULDBs).

Requirement N-18. Proposals for SCM investigations on high-altitude scientific balloons must be proposed for flight on Long Duration Balloons (LDBs) or Ultra Long Duration Balloons (ULDBs).

Investigations requiring flight on LDBs or ULDBs must provide a Letter of Feasibility from the NASA Balloon Program Office.

Requirement N-19. In addition to the requirements given in the SALMON-2 AO, all SCM investigations requiring flight on high-altitude scientific balloons must also provide a Letter of Feasibility from the NASA Balloon Program Office demonstrating that the proposed payload to be flown aboard LDBs or ULDBs can meet the access and accommodation requirements for balloon payloads. This Letter of Feasibility must contain: (1) a preliminary assessment of the feasibility of proposed provisions for access

to and accommodation on LDBs or ULDBs, (2) identification of known challenges and/or conditional provisions for access or accommodation, and (3) a description of the level of technical interchange and negotiation required to mature the proposed provisions for access and accommodation.

Proposers requiring a NASA Balloon Program Office Letter of Feasibility should contact
Debora Fairbrother
National Aeronautics and Space Administration
Balloon Program Office/Code 820
Wallops Flight Facility
Wallops Island, VA 23337
Telephone: 757-824-1453
E-mail: debora.a.fairbrother@nasa.gov

Additional information is found through the *Scientific Balloon Missions of Opportunity* document link in the Program Library. For any selected investigations, flight commitment to LDBs or ULDBs will be negotiated with the NASA Balloon Program Office during Phase A. Selection of any investigation to be flown aboard LDBs or ULDBs is conditional until negotiations for access and accommodation are successfully completed.

4.5.3.3 *Investigations Hosted on CubeSats*

SCMs may be proposed for flight on CubeSats. NASA provides launch opportunities for CubeSats as secondary payloads on U.S. Government missions. The CubeSat Launch Initiative is managed by the NASA Human Exploration and Operations Mission Directorate. See http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html.

For CubeSat proposals, all instruments/small satellites are recommended to comply with Cal Poly CubeSat Developer's specifications, found at <http://cubesat.calpoly.edu/index.php/documents/developers>. Concepts that do not comply with the Cal Poly CubeSat and Poly Picosat Orbital Deployer (P-POD) standards should clearly describe how their designs are packaged and deployed. NASA Launch Services Program has issued a *Program Level Dispenser and CubeSat Requirements Document* with requirements for CubeSats sized up to 6U (2U x 3U). All proposals for CubeSats sized up to 6U shall be compliant with these requirements. Both of these documents can also be found in the Program Library. No CubeSat form factors larger than 6U will be considered under the present call. Qualifying CubeSat form factors (size) include 1U, 1.5U, 2U, 3U and 6U with a mass not to exceed 1.33 kg per U.

Requirement N-20. All proposals involving sizes 1U through 6U CubeSats shall be compliant with the requirements in the NASA Launch Services Program *Program Level Dispenser and CubeSat Requirements Document*. No CubeSat form factors larger than 6U will be considered under the present call. Qualifying CubeSat form factors (size) include 1U, 1.5U, 2U, 3U and 6U with a mass not to exceed 1.33 kg per U.

For further information, please contact:

Anne E. Sweet,
Launch Services Program Executive,
Phone: 202-358-3784,
E-mail: anne.sweet-1@nasa.gov

or

Jason C Crusan,
Director, Advanced Exploration Systems
Phone: 202-358-0635,
E-mail: jason.crusan@nasa.gov

4.5.3.4 *Investigations on suborbital Reusable Launch Vehicles*

SCMs may be proposed for flight on suborbital Reusable Launch Vehicles (sRLVs). Access to sRLV platforms is managed by the Flight Opportunities Program within the Space Technology Mission Directorate. Information about sRLVs is available from the Flight Opportunities Program website at <http://flightopportunities.nasa.gov>. Additional information on sRLV vehicles, including general vehicle capabilities and contact information for some vendors, is available at <http://flightopportunities.nasa.gov/platforms>. The Flight Opportunities Program may advise proposers on the use of sRLV platforms, including the potential integration, safety and mission assurance, and operational costs. Proposers interested in using sRLVs must identify a vehicle that can provide the technical capabilities required to conduct the proposed investigation. SCMs to be flown on sRLVs must either be automated or remotely operated. Remote operation capability must be confirmed with the flight operator.

Requirement N-21. Proposals for investigations using sRLVs as platforms must specify the technical requirements that their investigation places on the vehicle. The proposal must include a Letter of Endorsement from a commercial vendor that (i) provides technical information on how the vehicle will meet the investigation requirements, (ii) states that the vehicle will be available for use at the time proposed for flight and provides information showing a plan for getting from the current vehicle status to flight status, and (iii) provides a quoted cost for the flight and all other services that are required from the vehicle vendor to enable and conduct the proposed investigation. Note that the Flight Opportunities Program is available to assist with (i) – (iii).

Questions concerning potential sRLV investigations may be addressed to:

LK Kubendran
Flight Opportunities
Space Technology Mission Directorate
NASA Headquarters
Washington, DC 20546
Telephone: 202-358-2528
E-mail: lk@nasa.gov

4.5.4 Risk Classification

This opportunity solicits proposals for science investigations requiring the development and operation of space-based investigations. The projects are designated as Category 3 as defined in NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*. The payloads are designated as Class D as defined in NPR 8705.4, Risk Classification for NASA Payloads, except for PMOs, which depend on host mission's risk classification requirements.

Requirement N-22. If any requirements to the proposed hardware that are more stringent than Class D (as appropriate) are needed, they must be clearly described in the proposal.

4.5.5 End-of-Mission Spacecraft Disposal

Section 5.3.10 of the SALMON-2 AO discusses the requirements related to end-of-mission spacecraft disposal for PMOs and hosted payloads where the PI is not responsible for the host mission. For these proposals, information shall be included regarding the plan for instrument passivation at the end of operations or in preparation for end-of-mission disposal. In addition, information shall be provided identifying instrument system components expected to survive Earth reentry if this is the postmission disposal method. This will allow NASA to remain in compliance with NPR 8715.6A, NASA Procedural Requirements for Limiting Orbital Debris, and NASA-STD-8719.14A, Process for Limiting Orbital Debris.

Requirement N-23. Proposals shall describe the instrument passivation plan at end of mission. In addition, proposals shall identify instrument components anticipated to survive Earth reentry if this is the disposal method. This supersedes Requirement 39 in the SALMON-2 AO.

4.5.6 Science Data Policy

4.5.6.1 Data Analysis

The PI will be responsible for analysis of the investigation data necessary to complete the proposed science objectives, for archiving the data in the relevant NASA astrophysics data archive for public use, and for timely publication of initial scientific results in refereed scientific journals, as part of their mission operations (Phase E) or postmission (Phase F) activities. Proposals must allocate sufficient resources for this data analysis and archiving. Science studies with the archived data sets beyond the PI-led teams proposed science investigation will be solicited and selected by NASA in subsequent NASA solicitations through ROSES NRAs.

Requirement N-24. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final on-orbit calibration and validation of the measurements. In accordance with the SMD requirement for open data and related software, any specialized software and algorithms required for basic data analysis and processing will be made available by the PI to the science community and public.

Requirement N-25. Proposals shall clearly present a plan for analysis of the mission data leading to completion of the proposed science investigation and achieving the identified

investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.5.6.2 *Data Rights*

By NASA policy, all science data returned from NASA investigations led by a NASA-funded PI are made available immediately in the public domain. Following a postflight checkout period, all data will be made available to the user community. There shall be no period of exclusive access. The principal investigator will propose the data product latency period for standard products listed in the proposal, and a justification for it must be demonstrated. Barring exceptional circumstances, data product latency may not exceed six months.

Requirement N-26. Proposals shall include a clear commitment to minimizing the latency for data products. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.5.6.3 *Delivery of Data to Archive*

Mission data will be made fully available to the public by the investigator team in usable form, in the minimum time necessary and, in any case, within the proposed data latency period not to exceed six months following data receipt from the spacecraft. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to making it fully available. By the investigation closeout, the investigation will deliver to the appropriate astrophysics data center all final data products, along with the scientific algorithm software, coefficients, ancillary data used to generate these products, and the algorithm and calibration documentation.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in flight), documentation, related software, and/or other tools or parameters that are necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large and provided within the proposed data latency period not to exceed six months following data receipt from the spacecraft.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of the appropriate NASA data archive.

Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the capped PI-Managed Investigation Cost.

Requirement N-27. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving shall be described. The science products (*e.g.*, flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) shall be

identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the formats and standards to be used. It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community.

4.5.6.4 *Sharing of Data from Partner Mission of Opportunity Investigations*

The data that are returned from Partner Mission of Opportunity investigations, at least from those aspects of the mission in which NASA is involved, shall be made available to the U.S. scientific community in a timely manner.

Requirement N-28. In addition to the requirements given in the SALMON-2 AO, all proposed PMO investigations must also provide: (1) a detailed description of the proposed provisions for sharing of science data, plans for returned scientific data, at least from those aspects of the mission in which NASA is involved, shall be made available to the U.S. scientific community in a timely manner, and the status of the host mission sponsoring agency's commitment to enter into an appropriate agreement with NASA for data sharing; and (2) a detailed explanation of how the U.S. astrophysics science community benefits from the proposed investigation.

4.6 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are referenced in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.4.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirements and constraints for that specific solicitation, including the sponsoring NASA Headquarters (HQ) mission directorate and division, the type of MO, the cost cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2, the cost cap is specified in Section 4.4.1, and the schedule constraint is specified in Section 4.4.2.
- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. For this PEA, the NASA Center for program office and the safety, reliability, and quality assurance document applicable to selected investigations are specified in Section 2.3.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the payload risk classification is specified in Section 4.5.4.

- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation by Aerospace in proposals. For this PEA, Section 4.1 states that there are no additional restrictions on participation by Aerospace in proposals.
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Mission Cost, the Total Mission Cost, and the Enhanced Mission Cost. For this PEA, that information is specified in Section 4.4.1. Only the PI-Managed Mission Cost is capped.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.4.1 and 4.4.2.
- Section 4.6 of the SALMON-2 AO states that each PEA will identify any NASA-provided launch services. For this PEA, NASA plans for access to space are discussed in Section 4.4.3.
- Section 5.2.5 of the SALMON-2 AO describes Science Enhancement Options (SEOs) for proposed investigations. SEOs are permitted for proposals in response to the PEA, and any SEO proposal must meet the requirements in Section 5.2.5 of the SALMON-2 AO.
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Sections 1.3 and 3 that a two-step competitive process is being used.
- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an Education and Public Outreach program that is consistent with SMD policy is required. This PEA does not require an Education and Public Outreach program; therefore Requirements 69 and 70 of the SALMON-2 AO do not apply to this PEA. However, NASA may impose E/PO requirements during or subsequent to the Phase A concept study phase.
- Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA.
- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by SMD and it does not permit contributions of funding from SMD programs other than the funding offered through this PEA.
- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection Official. This PEA identifies the Selection Official in Section 6.2.

4.7 Exceptions to General SALMON-2 Requirements

This PEA contains the following exceptions to the SALMON-2 proposal preparation and submission requirements described in the SALMON-2 AO.

- Proposals or portions of proposals requesting NASA funding shall report proposal costs in FY 2015 dollars as well in Real Year (RY) dollars. The former is for determining compliance with the PI-Managed Mission Cost cap requirement. The latter is for NASA SMD budget planning. This instruction supersedes the request for costs only in RY dollars described in Appendix B of the SALMON-2 AO including Table B-3.

- Section 4.5.6 of this PEA provides data policies and requirements that supersede those in Section 4.4 of the SALMON-2 AO.
- Section 4.5.5 provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO.
- This PEA does not require an Education and Public Outreach program.

5 PROPOSAL PREPARATION AND SUBMISSION

5.1 Proposal Content Requirements

Requirement N-29. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO.

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA reviewers.

The key data associated with the electronic submission of proposals (see Section 6.2 of the SALMON-2 AO) includes questions indicating whether or not a proposal contains export-controlled information (see Sections 5.9.4 and 5.10.2 of the SALMON-2 AO). All proposers must answer these questions YES or NO when completing the electronic submission; these questions shall not be left unanswered.

All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO. To the extent possible, ITAR sensitive material should be organized into separate clearly marked sections.

Requirement N-30. All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO.

The following Requirement supersedes Requirement B-15 of the SALMON-2 AO. It clarifies the information requested on the traceability of the proposed investigation, e.g., instrument performance requirements. A modified template is available on the Explorer Astrophysics 2014 Library to assist proposers on presentation of the investigation traceability.

Requirement N-31. Traceability from science goals to measurement requirements to instrument functional and performance requirements and to top-level mission requirements shall be provided in tabular form and supported by narrative discussion. Instrument projected performance shall be compared to the instrument performance requirements.

The following Requirement supersedes Requirement B-23 of the SALMON-2 AO and clarifies the information requested on instrument resource margins.

Requirement N-32. Instrument Contingencies and Margins: This section shall summarize contingencies and margins of all instrument resources. It shall provide estimates of implementation design margins with respect to the required performance or allocations

for mass, power, data storage, telemetry, and any other resource requirements. Discuss the allocation of contingency and margin to the instrument and/or suite (see SALMON-2 AO for definitions of contingency and margin).

The following Requirement supersedes Requirement B-24 of the SALMON-2 AO and clarifies the information requested on instrument performance margins.

Requirement N-33. Performance Margins: For each instrument performance, this section shall provide estimates of performance margin with respect to the performance requirements as compared to projected performance estimates and shall justify that these performance margins are appropriate.

The following Requirement supersedes requirement B-27 of the SALMON-2 AO and clarifies the information requested on new technologies and/or advanced engineering development.

Requirement N-34. This section shall describe any proposed new technologies and/or advanced engineering developments and the approaches that will be taken to reduce associated risks. Descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed system (level 3 WBS payload developments and level 3 WBS spacecraft elements) incorporating new technology and/or advanced engineering development at the time the proposal is submitted (for *TRL definitions*, see NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*, Appendix E, in the Program Library);
- Rationale for combining the TRL values of components and subsystems to derive each full system TRL as proposed, appropriately considering TRL states of integration (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*);
- Rationale for the stated TRL value of an element that is an adaptation of an existing element of known TRL;
- The approach for maturing each of the proposed systems to a minimum of TRL 6 by PDR:
 - Demonstration (testing) in a relevant environment can be accomplished at the system level or at lower level(s);
 - If applicable, justify what demonstration(s) in a relevant environment at lower level(s) (subsystem and/or subsystem-to-subsystem) would be sufficient to meet system level TRL 6, considering (i) where any new technology is to be inserted, (ii) the magnitude of engineering development to integrate elements, (iii) any inherent interdependencies between elements (e.g., critical alignments), and/or (iv) the complexity of interfaces – see the Program Library for examples;
 - Include discussion of simulations, prototyping, demonstration in a relevant environment, life testing, etc., as appropriate;
- An estimate of the resources (manpower, cost, and schedule) required to complete the technology and/or advanced engineering development; and
- Approaches to fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance liens they impose on the baseline design, and the decision milestones for their implementation.

If no new technologies or advanced engineering development is required, system TRL 6 or above at the time of proposal submission shall be clearly demonstrated.

5.2 Proposal Submission Requirements

Requirement N-35. Proposals must be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System, at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only.

Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement N-36. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

5.3 Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this PEA, or in the documents available through the Explorers Program Library, should be sent to the E-mail address for questions listed in Section 7 of this PEA. Responses that are helpful and informative to proposers will be posted on the website listed in Section 7 of this PEA.

The deadline for receipt of questions is two weeks before the proposal due date listed in Section 7 of this PEA.

6 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

6.2 Selection Process

After the review by the SMD AO Steering Committee, the evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the final selection(s). As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency, including the Director of the Astrophysics Division, concerning the selections.

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among top-rated proposals, including, but not limited to, planning and policy considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the mission directorate(s).

6.3 Implementation Activities

Proposal selection and award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO with the following amendments.

6.3.1 *Principal Investigator-led Team Masters Forum*

One step toward successful execution of PI-led missions is to ensure that PI-led mission management teams receive the instruction necessary to enable them to better execute their missions for NASA. SMD, in conjunction with the NASA Academy of Program, Project, and Systems Engineering Leadership (APPEL), has established a 2.5 day PI-led Team Masters Forum for newly selected PI-led mission management teams. The purpose of the PI-led Team Masters Forum is to facilitate knowledge sharing in areas that are deemed necessary to successfully execute PI-led SMD science missions. Course attendance by the leaders of newly selected PI-led mission management teams (PI, Project Manager, Project Scientist, and Project Systems Engineer) and the NASA Headquarters Program Scientist and Program Executive (where assigned) is required as soon as practical after proposal selection.

6.3.2 *Award Administration and Funding of Investigations*

Oversight management responsibilities have been assigned to the Explorers Program Office at the NASA Goddard Space Flight Center. The Explorers Program Office will authorize the release of funding to each selected investigation. The initiation of the investigation's award of the contract will take place as soon as possible after notification of selection. In order for contracts to be awarded, Statements of Work (SOWs) and updated cost and pricing data are required. If more than one contractual arrangement between NASA and the proposing team is required, separate SOWs and updated cost and pricing data are required for each contractual arrangement. NASA Centers will receive funding via intra-agency funding mechanisms.

Proposals are not required to include SOWs and cost and pricing data. These will be required only for investigations that are selected for award. For those investigations that are selected, it will be in the best interest of the PI-led investigation management teams to provide SOWs, cost and pricing data, and small business subcontracting plans in as timely a manner as possible. The process of awarding contracts cannot begin until final SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed.

SOWs will be required for selected investigations, regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). For contracts that exceed \$700K, the contractor will be required to provide cost and pricing data to support the cost estimate and to certify the cost proposed for the contract in accordance with FAR 15.406-2. Selected proposers should contact the Explorers Program Office at NASA Goddard Space Flight Center at Tel: 301-286-8212 as soon as possible after award regarding all SOW requirements.

For each selection, and unless otherwise stated in the selection letter, the selected investigation's cost cap will be set at the proposal's proposed cost.

NASA Centers shall follow their standard operation procedure for selecting teaming partners to facilitate the rapid implementation of their proposal, if selected, and this shall be documented in Appendix 6 of the proposal (see Appendix B, Section J.6, of the SALMON-2 AO).

6.3.3 *International Agreements*

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, the Science Division of NASA's Office of International and Interagency Relations will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail an exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency MOU. For additional policies and requirements, see Section 5.9 of the SALMON-2 AO.

7 SUMMARY OF KEY INFORMATION

Funding available	See Section 4.4.1 of this PEA
Community Announcement	November 2013
Release of Draft PEA Date	July 14, 2014
Comments Due on Draft PEA	August 4, 2014
Final PEA Release Date	September 17, 2014
Date for Preproposal Conference	October 7, 2014
Due Date for NOI (notice of intent to propose)	October 15, 2014
Due Date for Proposals	December 18, 2014
Selection Date for Competitive Phase A Studies	Summer 2015
Concept Study Reports Due	Summer 2016
Down-Selection Date	Early 2017
Web site for additional information for the Astrophysics Explorer MO PEA	http://explorers.larc.nasa.gov/APSMEX/MO/index.html
Program Library for the Astrophysics Explorer PEA	http://explorers.larc.nasa.gov/APSMEX/MO/program_library.html
Submission Medium	Electronic copies only; see Section 5.2 of this PEA
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)

NASA point of contact	Dr. Wilton Sanders Astrophysics Explorers Program Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-1319 E-mail: wilton.t.sanders@nasa.gov
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END OF PEA N

NNH12ZDA0060**SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)****NNH12ZDA0060-EUROPA****PROGRAM ELEMENT APPENDIX (PEA) O:
EUROPA INSTRUMENT INVESTIGATION**

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SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)

NNH12ZDA0060-EUROPA
PROGRAM ELEMENT APPENDIX (PEA) O:
EUROPA INSTRUMENT INVESTIGATIONS

1 BACKGROUND

1.1 Programmatic Overview

The National Aeronautics and Space Administration (NASA) Science Mission Directorate (SMD) Planetary Science Division (PSD) is currently formulating a mission to Europa that will address the science priorities described in the National Research Council's (NRC) 2012 Planetary Decadal Survey, *Vision and Voyages*. The goal of such a mission is to explore Europa to investigate its habitability. This Program Element Appendix (PEA) solicits proposals for instrument investigations relevant to a mission to Europa that either orbits the satellite or flies past it many times.

This solicitation calls for proposals for complete Principal Investigator led (PI-led) science investigations requiring spaceflight instrument development. This opportunity solicits flight instruments that do not require significant technology development. The term "complete" encompasses investigation phases from project initiation, through instrument development and science operations, to scientific analysis of space-based data. When deployed on the Europa mission, these spaceflight instruments will be used to conduct innovative, integrated, hypothesis- or question-driven investigations addressing the objectives of a Europa mission.

Proposed investigations will be evaluated and selected through a two-step competitive process (Section 6). Step-1 is the solicitation, submission, evaluation, and selection of proposals prepared in response to this PEA. As the outcome of Step-1, NASA intends to select approximately twenty Step-1 proposals totaling approximately \$25,000,000 Real Year (RY) dollars for development and technology maturation and issue awards (provide funding to NASA Centers and the Jet Propulsion Laboratory (JPL), award contracts to non-NASA institutions, or utilize other funding vehicles, as applicable) to the selected proposers to conduct Phase A concept studies and submit Concept Study Reports to NASA. Step-2 is the preparation, submission, evaluation, and continuation decision (downselection) of the Concept Study Reports. As the outcome of Step-2, NASA intends to continue approximately eight instrument investigations into the subsequent phases of mission development for flight and operations. At any time, NASA may condense the evaluation and selection process to a single step competitive process, resulting in final selection of investigations for development and flight operations at the end of Step-1. If NASA decides to condense the process no concept study contracts will be awarded. Selected instrument investigations will instead, as provided by contract, proceed directly to subsequent phases of development for flight and operations.

This PEA solicits investigations addressing any of the Europa science and reconnaissance objectives presented in Section 2.2 that can be achieved from instruments on a spacecraft either

orbiting Europa or flying past the satellite many times. Investigations requiring hardware or instruments deployed from and/or independent of the spacecraft are not solicited by this PEA.

Investigations that address NASA goals in other areas such as heliophysics, astrophysics, or Earth science are not solicited in this solicitation. Priority will be given to cost-effective instruments with significant science return, manageable cost risk, and demonstrated understanding of the challenges presented by the operational environment and associated mitigation plans for addressing those challenges.

NASA has not yet determined the scope and architecture of the Europa mission. While this PEA describes plans and dates (e.g., instrument delivery target dates, schedule for the solicitation and Step-2 study phase, etc.) proposers should be aware that these plans will adjust to programmatic decisions (e.g., mission architecture) made by NASA in the future. In particular, at any time NASA may choose without consultation with proposers to accelerate the schedule by condensing the evaluation and selection process to a single step competitive process. This will result in final selection of investigations for development and flight operations at the end of the first step.

1.2 Europa Exploration Background

The National Research Council's decadal survey in planetary science highly ranked the scientific value of Europa exploration, but recommended that NASA undertake an effort to reduce the cost and scope of such a mission. NASA continues to pursue that recommendation, and as part of the ongoing effort seeks to address the highest risk elements of a mission to Europa. Scientific instruments remain one of the greatest remaining risks from technical and cost standpoints.

NASA has not yet determined the scope and architecture of its Europa mission. Recent NASA studies have focused on an orbiter mission concept and a multiple flyby mission concept as the most compelling and feasible. The orbiter mission concept studied would orbit Europa for approximately three months, using a near circular polar orbit and a strawman payload consisting of five instruments to globally map Europa and acquire gravity and magnetic field measurements. The resource allocation for the orbiter payload in the study was approximately 74 kg and 103 W, with a total science data downlink of 524 Gbits.

The multiple flyby mission concept studied would pass close by Europa approximately 45 times, using a strawman payload consisting of seven instruments to conduct detailed investigations of globally distributed regions of Europa and acquire gravity and magnetic field measurements. The resource allocation for the flyby payload in the study was be approximately 107 kg and 153 W, with a total science data downlink of 36.5 Gbits per flyby. Both mission concepts also include instruments in the strawman payload dedicated to reconnaissance of potential future landing sites. The orbiter mission concept includes a high resolution reconnaissance camera, while the multiple flyby mission concept includes a high resolution reconnaissance camera as well as a thermal imager.

Table 1 lists the strawman payload defined by the NASA-sponsored Europa Science Definition Team (SDT) for both mission concepts. The SDT was deeply involved in the development of both the orbiter and multiple flyby mission concepts. These strawman instruments were identified and defined in order to achieve the science objectives specified for the two mission

concepts, but this list of candidate instrument types is only one of multiple possible "proofs-of-concept" - examples of potentially viable instrument sets that could meet the mission objectives. The list does not in any way restrict the possible approaches, nor is the list intended to preclude consideration of investigations that propose other instruments or combinations of instruments that can provide the necessary observations.

Orbiter Strawman Payload	Multiple Flyby Strawman Payload
<u>Science</u> Ice Penetrating Radar Laser Altimeter Mapping Camera Magnetometer Langmuir Probe <i>In situ</i> plume sample analysis	<u>Science</u> Ice Penetrating Radar Short Wave Infrared Spectrometer Topographic Imager Neutral Mass Spectrometer Magnetometer Langmuir Probe Gravity Science <i>In situ</i> plume sample analysis
<u>Reconnaissance</u> Recon Camera	<u>Reconnaissance</u> Recon Camera Thermal Instrument

Table 1. Strawman payloads from NASA studies of Europa orbiter and multiple flyby mission concepts. The *in situ* plume sample analysis strawman instrument was not identified by the SDT but reflects NASA's emphasis on the importance of plume investigations (see Section 2.2).

These two mission concepts represent NASA's most recent studies of Europa missions, with the flyby mission concept developed to greater fidelity. Information on these studies is provided in the Program Library since they represent the best information currently available on feasible Europa mission concepts. However, NASA has not yet finalized the mission architecture.

1.3 Overview of this Program Element Appendix

NASA issues this Program Element Appendix (PEA) as an appendix of the Second Stand Alone Missions of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO) for the purpose of soliciting proposals for Mission of Opportunity (MO) investigations to be implemented through the Planetary Science Division of the Science Mission Directorate. All investigations proposed in response to this solicitation must support the goals and objectives of the Planetary Science Division (Section 2.1) and this Europa Instrument Investigations element (Section 2.2). All proposed investigations must be implemented by PI-led investigation teams (Section 5.4 of the SALMON-2 AO).

Instrument investigations must provide a flight qualified spaceflight instrument or instrument package ready for integration to a NASA-determined spacecraft (Phase A-C), the technical support for integration onto a NASA-determined spacecraft (Phase D, see Section 4.4.1), the on-orbit operations, and the delivery of science quality data (Phase E), as described in Section 4.1 of the SALMON-2 AO.

Proposed investigations submitted in response to this PEA will be evaluated and selected through a two-step competitive process. As the outcome of the Step-1, NASA intends to select approximately twenty Step-1 proposals for development and technology maturation. As the outcome of Step-2, NASA intends to select approximately eight instrument investigations to proceed to the subsequent phases of mission development for flight and operations. At any time NASA may choose to condense the evaluation and selection process to a single step competitive process, resulting in final selection of investigations for development and flight operations at the end of the first step.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO contains additional requirements on the format and content of the proposals. Documents available in the Europa Program Library at <http://soma.larc.nasa.gov/europa/programLibrary.html> are intended to provide guidance for investigations selected; they are specifically not intended to impose requirements on proposals.

1.4 NASA On-line Document Information System

NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents are available through the NASA On-line Document Information System (NODIS) at <http://nodis3.gsfc.nasa.gov/>.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 NASA Planetary Science Goals

NASA's overarching goal in planetary science is to "ascertain the content, origin, and evolution of the solar system, and the potential for life elsewhere." NASA pursues this strategic goal by seeking answers to fundamental science questions that guide NASA's solar system exploration:

- How did our solar system form and evolve?
- Is there life beyond Earth?
- What are the hazards to life on Earth?

These questions have been translated into science goals that guide the focus of the division's science and research activities. These goals are:

- Explore and observe the objects in the solar system to understand how they formed and evolve;
- Advance the understanding of how the chemical and physical processes in our solar system operate, interact and evolve;
- Explore and find locations where life could have existed or could exist today;
- Improve our understanding of the origin and evolution of life on Earth to guide our search for life elsewhere; and
- Identify and characterize objects in the solar system that pose threats to Earth, or offer resources for human exploration.

Further information on NASA's strategic goals can be found in the *2014 NASA Strategic Plan*, and information on NASA's strategic objective and science goals for planetary science can be found in the *2014 Science Plan*. Both documents are available through the Program Library.

2.2 Europa Science Goals and Objectives

Europa exploration has consistently been rated as among the highest priority scientific pursuits for NASA because it addresses the fundamental question of life beyond Earth. The goal of any mission to Europa as set forth by the NRC decadal survey for planetary science is to explore Europa to investigate its habitability. The decadal survey further provided the following science objectives for Europa exploration (in priority order):

1. Characterize the extent of the ocean and its relation to the deeper interior.
2. Characterize the ice shell and any subsurface water, including their heterogeneity, and the nature of surface-ice-ocean exchange.
3. Determine global surface compositions and chemistry, especially as related to habitability.
4. Understand the formation of surface features, including sites of recent or current activity, and identify and characterize candidate sites for future *in situ* exploration.
5. Understand Europa's space environment and interaction with Jupiter's magnetosphere.

While characterizing landing sites for future *in situ* exploration is the fourth scientific priority in the Planetary Decadal Survey, NASA places high programmatic priority on this goal to enable a potential future lander mission to Europa. Since current data does not provide sufficient information to identify landing sites and design a landing system capable of safely reaching the surface, NASA has defined the following programmatic reconnaissance objective:

- Characterize scientifically compelling sites, and hazards, for a potential future landed mission to Europa.

Proposals to this PEA must be responsive to one or more of the six objectives above.

The potential existence of large plumes of water vapor emitted from Europa's surface has exciting implications for future spacecraft exploration of this icy world. Although the evidence from Hubble Space Telescope observations presently awaits confirmation, the analogy to active plumes at Enceladus has motivated discussion of how detection and characterization of plumes should be incorporated into Europa exploration. The Europa SDT convened a workshop in June 2014 to discuss this topic. While its findings in part stated that based on the available evidence the science objectives for Europa exploration remain valid and that plume investigations should not drive mission architecture itself, the scientific potential presented by the plumes is sufficiently high that NASA will continue to emphasize the importance of plume investigations and encourages instrument investigations focused on this area. The full report is available in the Program Library.

2.3 Accommodation of Europa Instruments

The objective of this solicitation is to select Instrument Investigations where instruments are built and deployed on a spacecraft followed by production of high quality and highly useful science data from that instrumentation. Instrument investigations will be proposed without a firm identification of the spacecraft to accommodate these instruments. Therefore, selection of proposals from this solicitation will take into account the “accommodability” of the proposed instruments, as well as the value of the science to be returned from the selected investigations.

Since the Europa mission architecture and spacecraft are not yet defined, the available payload resources, including size, mass, power, thermal control, pointing stability, pointing ability, orbits, and data rates, cannot be provided at this time. Values from the NASA studies of an orbiter and multiple flyby mission concepts are provided as illustrative and realistic examples only. Eventually the instruments provided through this PEA will have to work within the available payload resources. Proposers are encouraged to review the constraints described in the reports for the orbiter and multiple flyby mission concepts since they represent NASA’s current best assessment of feasible mission implementations. Table 2 lists critical parameters and current resource estimates for the payloads for the orbiter and multiple flyby mission concepts. This information reflects NASA’s best understanding of mission concepts that are judged to be both compelling and feasible. However, the final mission architecture and its associated payload parameters and resources are not yet determined. Proposed instruments that cannot meet many of the requirements anticipated for likely mission architectures will be seen as a higher risk for accommodation than those that have higher specification margins. A higher risk for accommodation in and of itself does not necessarily disqualify an instrument investigation from selection at Step-1.

2.4 NASA Management of Europa Instrument Investigations

The selected investigation(s) will be managed by the Discovery/New Frontiers Program Office (D/NF PO). The Associate Administrator for SMD has established the D/NF PO at the NASA Marshall Space Flight Center (MSFC) to be responsible for project oversight. The D/NF PO Program Manager at NASA MSFC reports to the Deputy Division Director within the Planetary Science Division at NASA Headquarters. There are appropriate protective firewalls between the D/NF PO and the rest of NASA MSFC, allowing investigators from NASA MSFC to propose in response to this PEA. The D/NF PO will manage the Europa instrument investigations under the requirements of NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, as described in Section 4.1.2 of the SALMON-2 AO.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

This solicitation is an appendix to the NASA SALMON-2 AO. The SALMON-2 AO provides the overall structure and guidelines for several types of mission of opportunity solicitations. Each new opportunity is announced with a Program Element Appendix (PEA). This document is such a PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com> and at <http://go.nasa.gov/SALMON2-AO>.

This PEA solicits planetary science investigations that include the development of instruments to be provided to and integrated with a yet-to-be-identified space platform and integrated with a yet-to-be-identified launch vehicle.

Evaluation and selection will be done using a two-step selection process; a competitive Phase A (Step-2) and down selection is planned. At any time NASA may choose to condense the evaluation and selection process to a single step competitive process, resulting in final selection of investigations for development and flight operations at the end of the first step.

Table 2. Critical parameters and resource estimates from NASA studies of Europa orbiter and multiple flyby mission concepts. These values are taken from the Europa Summer Study Final Report and the Europa Clipper Science and Reconnaissance Payload Proposal Information Package posted in the Program Library.

		Orbiter¹	Multiple Flyby²
Mass		74.2 kg (includes 13.2 kg shielding ³)	107.4 kg (includes 18.1 kg shielding ³)
Power		103.3 W	153.3 W
Energy per flyby/orbit		Steady State Operations	670 Whr
Pointing	<i>Control</i>	5.0 mrad	7.0 mrad
	<i>Knowledge</i>	0.5 mrad	0.7 / 4.0 / 0.7 mrad (X,Y,Z)
	<i>Stability</i>	± 25 µrad/sec	± 25 µrad/sec over 3 sec
Data Rates	<i>MIL-STD-1553B</i>	-	200 kbps
	<i>10/100 Ethernet</i>	-	100 Mbps
	<i>SpaceWire</i>	100 Mbps	-
Data volume per flyby/orbit		524 Gbits for mission	36.5 Gbits/flyby (~1,642 Gbits for mission) ⁴
Mission Total Ionizing Dose (TID)		TID of ~4.0 Mrad behind 100 mil Al (Si equivalent)	TID of ~2.7 Mrad behind 100 mil Al (Si equivalent) ⁵
Radiation Hardened Parts Rating		RDF of 2 is required; Vault provides shielding to 150 krad (Si) ⁶	RDF of 2 is required; Vault provides shielding to 150 krad (Si) ⁶
Instrument Lifetime		<10 years launch to EOM	11 years launch to EOM ²
Science Mission Duration		108 days in orbit ⁷	45 flybys ^{2,7}

¹Europa Summer Study Final Report, December 13, 2012

²Europa Clipper Science and Reconnaissance Payload Proposal Information Package, May 29, 2014

³Shielding for detectors/electronics outside the vault.

⁴Additional 12 Gbits per orbit assumed for calibration data.

⁵Based on improved GIRE-2 radiation model; for direct comparison of Europa Clipper with Europa Orbiter GIRE-1 the equivalent is 2.1 Mrad.

⁶Local shielding required to comply with RDF of 2 requirement.

⁷Extended missions possible for flybys only within resource margins and limited for orbits due to radiation environment.

The following schedule applies to this PEA:

PEA Release Date.....	July 15, 2014
Preproposal Conference.....	July 2014, ~2 weeks after PEA release via remote meeting
Notice of Intent to Propose Deadline.....	August 15, 2014
Proposal Submittal Deadline.....	October 17, 2014
Step-1 Selections Announced (target)	April 2015
Initiate Phase A Concept Studies (target)	May 2015
Phase A Concept Study Reports due (target)	December 2015
Downselection of investigations for flight (target)	April 2016
Instrument Delivery Date for Integration.....	January 2021

A Preproposal Conference will take place in association with this solicitation. Further information will be available at the Europa Instrument Acquisition website (see Section 7 of this PEA) prior to the Preproposal Conference.

Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA. The period for questions will close three weeks before the proposal due date.

A Notice of Intent (NOI) to propose to this announcement is extremely helpful to NASA for purposes of planning the proposal evaluation, and, therefore, is strongly encouraged. It is desired by NASA SMD that all NOIs have the entire investigation team identified within the NOI to allow for the identification of unconflicted evaluators by the proposal due date. NASA SMD requests that proposers communicate any changes to the investigation team between NOI and proposal submission to the Europa Program Scientist identified in Section 7 of this PEA. NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Section 6.1.2 of the SALMON-2 AO provides information on electronic NOI submission through NSPIRES. Submitting an NOI does not commit the team to submitting a proposal. All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.

NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four weeks following receipt of the Statement of Work, as set forth in Section 6.3.1 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Propose

Refer to Section 4.2 of the SALMON-2 AO for the rules on participation policy. For this particular PEA, NASA will place full or partial limitations (as described in the SALMON-2 AO) on organizations that will be involved in the evaluation process. Cornell Technical Services LLC (CTS) is subject to the “Full Limitation” as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on The Aerospace Corporation for this Europa Instrument PEA.

4.2 Type of Mission of Opportunity

In the context of the SALMON-2 AO, this PEA is a Focused Mission of Opportunity (FMO). A FMO is one that addresses a specific, NASA-identified flight opportunity that fulfills the solicited objectives and includes all of the elements specified in this document and in the SALMON-2 AO.

The investigation PI is responsible for conducting the proposed science investigation which includes, but is not limited to: (i) development and delivery of the instrument or instrument package; (ii) working with NASA to integrate the instrument on the NASA-chosen platform; (iii) commissioning, validating, and operating the instrument and ground systems on-orbit in order to carry out the proposed science investigation; (iv) preparing and delivering appropriate data analysis software, including required calibration data, analyzing the data, publicly distributing all the proposed investigation data from the prime mission phase to the scientific community, archiving the data in a NASA-chosen Distributed Active Archive Center (DAAC), and reporting the results of the science investigation in the scientific literature.

4.3 Science Requirements and Constraints

The science objectives are fully described in Section 2 of this PEA. Any appropriate science question relevant to the Europa science objectives can be addressed with the proposed investigations. Section 2 provides the basis for the evaluation of intrinsic science merit as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside Europa science objectives as described in Section 2 are not solicited through this call.

Requirement O-1. Proposals shall address appropriate science questions relevant to planetary science and Europa objectives as described in Section 2 of this PEA.

Requirement O-2. Each proposal shall clearly define its science question or questions, shall demonstrate how the science questions map into high-level science requirements, and shall show how the science requirements subsequently map into the measurement and instrument performance requirements.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement O-3. Each proposal shall clearly state the baseline and threshold requirements for the performance of the instrument, the prime mission lifetime for operation of the instrument, whether the investigation is intended for a Europa orbiter or flyby mission architecture (or both), and the range of spacecraft orbits acceptable or required for operation of the instrument.

A Co-Investigator (Co-I) is defined as an investigator who plays a necessary role in the proposed investigation and whose services are either funded by NASA or are contributed by his/her employer. Every Co-I must have a role that is required for the successful development and/or operation (including initial data analysis) of the instrument science investigation, and the necessity of that role must be justified. Co-Is with roles limited to operations and/or initial data analysis need not be named at this time, but may be identified by the PI after launch, with NASA

concurrence. In such cases the role, expertise, and budget for the unnamed Co-I should be included in the proposal. The inclusion of any unjustified Co-Is will result in the downgrading of an investigation and/or the offer of only a partial selection by NASA.

Requirement O-4. Proposals shall designate all Co-Is, describe the role of each Co-I in the instrument investigation, state the annual time commitment of each Co-I, and justify the necessary nature of the role; see Section 5.6 of the SALMON-2 AO.

NASA expects each proposal to fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the selected PI-led investigation, the proposals should provide information about the commitment to funding for those data in the time line of 5-10 years after selection of the investigation and describe the implications to meeting the science requirements if such data do not exist.

Requirement O-5. Each proposal shall fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the selected PI-led investigation, the proposals shall provide information about the expectations for available calibration and validation instruments and/or data in the time line of 5-10 years after selection of the investigation and describe the implications to meeting the science requirements if such activities do not exist.

4.4 Cost and Schedule Requirements and Constraints

4.4.1 Cost Requirements and Constraints

There is no predetermined cost cap for the payload as a whole or for specific instrument types within the payload. Cost estimates performed for the orbiter and multiple flyby mission concepts indicated that approximately 15% of the total mission cost, excluding launch vehicle, was needed for the development and operation of the science payload. Cost will be a significant driver in the payload selection. The level of funding available for each selected proposal will be decided on a case-by-case basis and will be capped at that level.

4.4.1.1 PI-Managed Investigation Cost

Each selected investigation is PI-Managed, and the PI will be responsible for defining and controlling the costs within the proposed budget for each phase of the investigation. Since NASA will be arranging the spacecraft for the instrument investigations, some costs cannot be defined and controlled by the PI, and these costs will be outside the established PI-Managed Investigation Cost. This section identifies those costs that are constrained within the PI-Managed Investigation Cost and those where NASA requires planning budgets that are outside the constrained PI-Managed Investigation Cost. A summary of budgeted costs that are and are not to be included in the PI-Managed cost cap for Instrument Investigations is listed in Table 3.

Contributions from sources other than NASA, whether U.S. or non-U.S., are welcome. These may include, but are not limited to, labor, services, and/or contributions to the instrument investigation, subject to the following exceptions and limitations: contributions of non-U.S. nuclear power or thermal sources are prohibited.

Costs that are within the PI-Managed Investigation Cost include: instrument development and delivery ready for integration onto the selected platform (Phases A-C); labor required to assist with integration to the NASA-provided platform (Phase D); development and delivery of functional algorithms and ground processing system (Phases B-D); supporting a science team that will contribute directly to the successful implementation of the investigation (Phases A-F); required calibration and validation activities (Phases C-E); operations, product generation, and data analysis during the proposed prime mission lifetime of the investigation (Phases E); and close out of the investigation once the investigation has been concluded (Phase F). The PI-Managed Investigation Cost also includes the cost of the science team and of key management, instrument, and engineering staff during Phase D. For support of the science team and key management and engineering during Phase D, a duration of 20 months should be assumed for budgeting purposes.

It is expected that minor changes may be required to a selected instrument investigation once an appropriate platform is determined and announced. It is also understood that more significant changes possibly required to respond to NASA programmatic decisions could alter the proposed PI-Managed Investigation Cost between Step-1 and Step-2.

Costs that are outside the PI-Managed Investigation Cost include investigation costs during any potential gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D); access to space, which is provided by NASA; and contributions from sources other than NASA, including both U.S. and non-U.S. sources.

NASA also requires proposals to include plans and planning budgets that estimate the minimum costs for the project if there is a gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D). These “gap planning” budgets should be on a per-year basis up to a maximum of four years. The costs for these planning budgets are outside of the PI-Managed Investigation Cost.

Proposers should propose a funding profile that is appropriate for their investigation. However, NASA cannot guarantee that every proposed funding profile can be accommodated within the Europa budget. The inability of NASA to accommodate the requested funding profile may be a reason for nonselection of a proposal. A final funding profile for all selected investigations will be negotiated between NASA and the selected investigation team.

Requirement O-6. Proposals shall be for complete investigations including Phases A-F.

Requirement O-7. Proposals shall include detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Investigation Cost (see Table 3).

Requirement O-8. Proposals shall include integration plans and planning budgets that occur during Phase D, with the assumption that this phase will take approximately 20 months. This cost is included as part of the PI-Managed Investigation Cost.

Portion of the Investigation	Within PI-Managed Costs	Outside PI-Managed Costs
Phase A	X	
Phase B	X	
Phase C	X	
Phase D	X	
Investigation Costs during a potential gap between completion of instrument and start of integration (planning budget up to 4 years, on a per-year basis)		X
Cal/Val planning (all phases)	X	
Postlaunch instrument commissioning activity (within Phase D)	X	
Phase E	X	
Phase F	X	
Cost for access to space		X
Non-NASA Contributions		X
Core E/PO program, not required, see section 4.6.		X
Student Collaboration (SC) (optional)	X	

Table 3. List of which portions of an instrument investigation are within and outside the PI-Managed Investigation Cost. Budgets for items within and outside of PI-Managed Investigation Costs are required except for access to space and E/PO.

Requirement O-9. Proposals shall include plans and planning budgets for the required costs to minimally support the project and science during a potential gap between instrument delivery (end of Phase C) and the start of integration with the spacecraft (start of Phase D). These budgets should be on a per year basis for up to four years. These costs are outside the PI-Managed Investigation Cost.

4.4.1.2 Full Cost Accounting for NASA Facilities and Personnel

This Section supersedes Section 5.5.5 of the SALMON-2 AO.

For the purpose of calculating the full cost of NASA provided services, proposal budgets from NASA Centers, whether as the proposing organization or as a supporting organization, are to include within the PI Managed Investigation Cost all costs normally funded by an SMD Project under NASA's full cost accounting practices, including civil servant labor (salaries and benefits), civil service travel, and procurements. All of these costs must be clearly identified by year within the budget justification section of the proposal.

Estimated NASA Center Management and Operations (CM&O) overhead costs must also be included within the budget, to enable a level playing field for all proposers. Per HQ policy guidance signed in June 2010 by the Associate Administrator, Mission Support Directorate and by the Agency Chief Financial Officer, all Centers shall use an identical CM&O burden rate of \$43K (RY) per "equivalent head." As per Agency policy, this rate must be applied as a "cost per equivalent head" to all Civil Service FTEs plus on/near site contractor WYEs associated with the

proposal. The estimated FTEs and WYEs per fiscal year, and the resulting CM&O burden, must be identified in a separate table within the budget justification section of the proposal.

The CM&O burden costs must be clearly denoted in all budget tables. These costs may not be included or rolled into any other budget lines in such a way that they become unidentifiable.

Do not include within the cost proposal, or within the PI Managed Investigation Cost, any estimate for Agency Management and Operations (AM&O, a.k.a. NASA Headquarters overhead).

	Identify in proposal?	Include in PI-managed Investigation cost?	Funding source	Comments
Civil Service Labor	Yes	Yes	SMD Program	Includes salaries and benefits
Civil Service Travel	Yes	Yes	SMD Program	
Other Direct/Procurements	Yes	Yes	SMD Program	Includes procurements as typically identified by flight projects in the NASA N2 budget database
CM&O	Yes	Yes	CASP	Applied to NASA provided labor, including Center civil servants and on-site contractors
AM&O	No	No	CASP	
NASA Contributed Costs	Yes	No	Identify	Must be non-SMD
Non-NASA Federal Government (funding requested from NASA)	Yes	Yes	SMD Program	If NASA funding is requested for the non-NASA Federal Government agency
Contributions	Yes	No	Identify	Includes all non-NASA contributions

Table 4. Cost Elements for NASA Center Budget Proposals in response to SMD AOs

Requirement O-10. Proposals including costs for NASA Centers shall conform to the full cost policy stated in this Section. Each of the elements of the NASA Center costs (direct labor, travel, procurements) shall be separately identified by year.

If any NASA funded item(s) or services are to be considered as contributed costs, then the contributed item(s) must be separately funded by a non-SMD effort complementary to the proposed investigation, the value of the contribution(s) must be estimated, and the funding source(s) must be identified.

Requirement O-11. If any NASA funded item(s) or services are considered as contributed costs, then the proposal shall estimate the value of the contribution(s) and shall identify the funding source(s).

Any non-NASA Federal Government costs must follow the appropriate agency accounting standards for full cost. If no standards are in effect, the proposers must follow the Managerial Cost Accounting Concepts and Standards for the Federal Government, as recommended by the Federal Accounting Standards Advisory Board and available in the Program Library.

Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

4.4.1.3 Cost of the Phase A Concept Study

Proposers selected through this PEA will be awarded a contract (if not at a NASA Center or JPL) to conduct a Phase A concept study with a duration of approximately seven months following the establishment of initial contracts. The cost of the Phase A concept study is capped at \$1.25M RY dollars. See Sections 6.3.1 and 6.3.2 for additional information on the Phase A concept study.

Requirement O-12. Proposals shall include the cost of the Phase A concept study, which shall be included within the PI-Managed Investigation Cost.

4.4.2 Schedule Requirements and Constraints

Each selected instrument investigation under this Europa instrument investigation solicitation will be expected to deliver an instrument that can be integrated by January 2021 onto a NASA-determined platform. Nominally, the development of the selected investigation(s) will span the years of FY 2015-FY 2021. This is expected to cover development Phases A through C. Proposals that include a more rapid instrument development timelines may be selected, provided the required budget phasing can be accommodated by NASA.

Requirement O-13. Proposals shall include a development schedule that delivers an instrument for integration onto the selected platform no later than January 2021 and completes integration within approximately 20 months.

4.5 Technical Requirements and Constraints

4.5.1 New Technologies/Advanced Engineering Development

This Section intends to clarify the requirement for New Technologies and/or Advanced Engineering Developments and supersedes Section 5.3.4 of the SALMON-2 AO.

This AO solicits instruments for flight missions, not technology or advanced engineering development projects. Proposed investigations are generally expected to have mature technologies, with systems at a Technology Readiness Level (TRL) of 6 or higher. For the purpose of TRL assessment, systems are defined as level 3 WBS payload developments (i.e., individual instruments); see Figure 3-7 of the *NASA WBS Handbook*, NASA/SP-2010-3404, which can be found in the Program Library. TRLs are defined in NPR 7123.1B *NASA Systems*

Engineering Processes and Requirements, Appendix E, which can be found in the Program Library.

Proposals with a limited number of less mature technologies and/or advanced engineering developments are permitted as long as they contain a plan for maturing systems to TRL 6 (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*) by no later than Preliminary Design Review (PDR) and adequate backup plans that will provide mitigation in the event that the systems cannot be matured as planned. The TRL state of systems will be validated by an independent team at PDR.

Requirement O-14. Proposals that use systems currently at less than TRL 6 shall include a plan for system maturation to TRL 6 by no later than PDR and a backup plan in the event that the proposed systems cannot be matured as planned (see Section 5.1 of this PEA, for additional detail).

4.5.2 Europa Radiation Environment

Any mission to Europa faces significant challenges involving the harsh radiation environment. Typical total ionizing dosages for Europa missions studied by NASA exceed 2 megarads with high fluxes near Europa. Instruments may be particularly susceptible to this radiation environment.

Requirement O-15. Proposals shall discuss in detail the radiation shielding/hardening design and strategy and the associated radiation hardened hardware for all proposed instrument components.

4.5.3 Planetary Protection

Planetary Protection requirements for Europa are very strict and involve ensuring that the probability of introducing a viable Earth organism into Europa's ocean is $<1 \times 10^{-4}$.

To demonstrate compliance, the spacecraft and its payload may need to be sterilized (for example, via dry heat microbial reduction). Proposers should provide a strategy and associated risk to meet the planetary protection needs of a Europa mission.

Investigations are subject to the established NASA policies and procedures that address forward contamination (transmittal from Earth to a targeted solar system body) and backward contamination (transmittal to Earth from the targeted body) with respect to other solar system bodies (see NPD 8020.7G, *Biological Contamination Control for Outbound and Inbound Planetary Spacecraft*; NPR 8020.12C, *Planetary Protection Provisions for Robotic Extraterrestrial Missions*; and NASA-HDBK-6022, *NASA Handbook for the Microbiological Examination of Space Hardware (DRAFT)*, in the Program Library). Note that forward contamination is of particular concern for possible liquid water bodies within icy satellites.

For additional information, proposers may contact the NASA Planetary Protection Officer, Dr. Catharine A. Conley (Telephone: 202-358-3912; E-mail: cassie.conley@nasa.gov).

Requirement O-16. Proposals shall address plans for contamination control, as required by NPD 8020.7G and NPR 8020.12C; such investigations shall bear all additional costs generated by any special planetary protection requirements.

4.5.4 Instrument Investigation Science Instrument System and Platform Interfaces

Because there is no defined platform that directly constrains the design of the proposed instrument characteristics and observing strategy, this PEA does not list specific or final requirements for mass, instrument dimensions, power consumption, data rate requirements, platform stabilization requirements, observational geometry requirements, launch vibration constraints, or desired orbit. However, all of these parameters must be well characterized and clearly stated within the proposal, preferably in a single table, in order for NASA to determine the feasibility of accommodating the proposed instrument investigation on an appropriate platform in the near future.

Requirement O-17. Proposals shall clearly state the proposed instrument mass, volume dimensions, power requirements, platform stabilization requirements, thermal requirements, observational geometry requirements, launch vibration constraints, electromagnetic interference/electromagnetic compatibility (EMI/EMC) requirements, data rate requirements, and all other requirements (or constraints, preferences, etc.) that the instrument places on the platform for accommodation, launch, deployment, operations, etc. A template is provided on the Program Library to aid proposers to provide this data. This table shall be provided in the experiment implementation section (Section E) of the proposal. This table does not count towards the proposal page limit.

Requirement O-18. NASA recognizes that the full depth of information requested in Requirement O-17 may not be available at Step-1. In such cases proposals shall contain an explanation as to why the information is not available, justify that the development of that aspect is not required at this stage and that it is acceptable to develop details later, and explain why the lack of information at this stage does not translate into a risk to the proposer's ability to implement the investigation as proposed. The approach for developing the required depth of information, along with a corresponding development schedule, shall be included among the plans for future activity.

Proposals may include information on any research the proposing team has done relative to potential payload accommodations for their proposed instrument. This is not a requirement for any proposal. However, such information can serve to demonstrate to NASA the potential of accommodating the proposed instrument. If a proposal includes such information, effort should be made to address all known integration criteria and make clear which integration criteria have not been completely researched. Failure to include such research will not be counted against a proposal in evaluation. Inclusion of such information has the potential to support the arguments within a proposal that the instrument has an acceptable chance of being integrated on a platform within an appropriate time frame.

4.5.5 Orbit Requirements

The mission architectures under consideration (orbiter and multiple flyby) present distinct orbit and environmental requirements on the payload. Proposers must consider these requirements

and describe the instrument investigation's ability to operate in these orbits and their associated environments.

Requirement O-19. Proposals shall clearly state the ability of the instrument to operate in the orbits and environments expected for a Europa spacecraft and provide operational constraints (e.g., duty cycle or observational cadence) on the instrument. Proposals shall specify if the instrument investigation is intended for an orbiter or flyby mission architecture (or both) and clearly state the desired and acceptable orbits.

4.5.6 Payload Risk Classification

NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, establishes guidelines for categorizing NASA missions based on the estimated total mission cost and mission priority level. The mission categorization guidelines are given in Section 2.1.4 and Table 2-1 of NPR 7120.5E.

NPR 8705.4, *Risk Classification for NASA Payloads*, establishes baseline criteria that enable a definition of the risk classification level for NASA payloads. It defines four payload risk levels or classes, A through D, and provides guidance for programmatic options during development based on this class. The requirements for each class are specified in Appendix B of NPR 8705.4.

NASA expects to designate the Europa mission as a Category 1 mission (per NPR 7120.5E) and payload risk Class A (per NPR 8705.4). Proposers are advised that instruments will be managed within a corresponding framework and that requirements will be flowed down to the instrument investigations. Proposers shall incorporate appropriate work effort and support in their proposals accordingly.

4.5.7 End-of Mission Spacecraft Disposal

This Section provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO.

Section 5.3.10 of the SALMON-2 AO discusses the requirements related to end-of-mission spacecraft disposal for Partner Missions of Opportunity and hosted payloads where the PI is not responsible for the host mission. For instrument investigation proposals, information shall be included regarding the instrument's plan for passivation at the end of operations or in preparation for end-of-mission disposal.

Requirement O-20. Instrument investigation proposals shall describe the instrument's passivation plans at end-of-mission. This supersedes Requirement 39 in the SALMON-2 AO for instrument investigation proposals.

4.5.8 Science Data Policy

This Section provides data policies and supersedes Section 4.4 of the SALMON-2 AO.

For planning purposes for proposals, proposers responding to this PEA should abide by the science data policy described below. Selected instrument investigations will be expected to abide by the science data policies eventually finalized by the Europa science team and NASA.

4.5.8.1 Data Analysis

The PI will be responsible for analysis of the investigation data necessary to achieve the proposed science objectives, for publicly distributing all data collected by the instrument(s) and produced by the investigation prime measurement phase, for archiving the data in the NASA selected DAAC for public use, and for timely publication of initial scientific data in refereed scientific journals, as part of their investigation operations (Phase E) or postmission activities. Science studies with the archived data sets beyond the science investigations proposed by PI-led team will be solicited and selected by NASA in subsequent NASA solicitations through the Research Opportunities in Space and Earth Sciences (ROSES) NASA Research Announcement.

Initial data analyses for the investigations solicited here will be accomplished by the PIs and their teams. Therefore, proposers are expected to include, as part of their proposed investigation Operations and Data Analysis activities, a clear definition of the roles of all the investigation team members and a data analysis plan that is consistent with Planetary Data System (PDS) archiving activities. Cost estimates for PI investigation instrument team activities will cover all phases, including investigation operations and data analysis.

Instrument investigations are required to share data with the broader Europa science team members so as to enhance the scientific return from the mission in accordance with the procedures to be agreed and formalized within the mission science team.

Requirement O-21. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final flight calibration and validation of the measurements. In accordance with the SMD requirement for open data and related software, any specialized software and algorithms required for basic data analysis and processing will be made available by the PI to the science community and public with appropriate documentation.

Requirement O-22. Proposals shall clearly present a plan for analysis of the investigation data leading to completion of the proposed science investigation and achieving the identified investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.5.8.2 Data Rights

By NASA policy, PIs do not have exclusive use of data taken during their investigation; all data is nonproprietary and made available in the public domain as rapidly as possible. Following a postflight checkout period, all data will be made available to the user community. There shall be no period of exclusive access. The principal investigator shall propose and justify the data product latency period for standard products listed in the proposal, based primarily on the time required to produce, quality-check, and validate the products. Barring exceptional circumstances, data product latency may not exceed six months. Image data is to be made available publicly shortly after reception on the ground.

Requirement O-23. Proposals shall include a clear commitment to minimizing the latency for data products. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.5.8.3 *Delivery of Data to Archive*

Investigation data will be made fully available to the public by the investigator team through the PDS in usable form, in the minimum time necessary and, barring exceptional circumstances, within six months following its collection. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to making it fully available. By no later than the investigation closeout, the investigation will deliver to the PDS all final data products, along with the scientific algorithm software, coefficients, ancillary data used to generate these products, and the algorithm and calibration documentation.

Archival data products will include pre-flight and in flight radiometric and geometric calibration data, ancillary and/or engineering data needed or simply useful for the full understanding of the experiment, and observation geometry data (such as that supplied by valid SPICE kernels). Additionally, low-level (raw) data, high-level (processed) data, and derived data products (such as maps, ancillary data, calibration data (ground and in-flight)) will be included in the archival data products. If derived data products such as maps are to be considered a result of the proposed experiment, these must also be archived with suitable documentation. Complete documentation of the experiment and related software and/or other tools or parameters that are necessary to interpret the data shall also be included. The inclusion of software in an archive may be appropriate, although this can present special problems and should be discussed with the relevant archive.

The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large.

International coordinate system and nomenclature standards are required to be used when archiving data and products into the PDS (<http://pds.nasa.gov/documents/sr/Chapter02.pdf>). Additionally, data archived in the PDS must be compliant with the PDS's "PDS4" archive standards (which have been also adopted by the International Planetary Data Alliance).

The International Astronomical Union (IAU) approves international standards for coordinate systems and nomenclature. Appropriate working groups and their contact information can be found by following links from (<http://astrogeology.usgs.gov/groups>). NASA's Planetary Cartography Program maintains the core software infrastructure for cartographic processing of a variety of planetary data sets but does not fund mission specific applications needed to utilize this infrastructure. More information on this software is available from (<http://isis.astrogeology.usgs.gov/>). If proposing to produce geologic maps, extensive guidelines and other materials are available through the NASA/USGS Planetary Geologic Mapping Program (<http://planetarymapping.wr.usgs.gov>). NASA funds open facilities for producing stereogrammetric and radargrammetric topography and geographical information system products. Information on the capabilities of these facilities and contact information for their

leads can be found at (http://astrogeology.usgs.gov/facilities/photogrammetry_guest_facility) and (<http://astrogeology.usgs.gov/facilities/mrctr>). The photogrammetry guest facility also provides limited support for investigators wishing to make their own digital topographic models from planetary stereo images.

All archive submissions must go through a peer review organized by the PDS. Each data provider must participate in the peer review and will be responsible for correcting any liens identified. Data will not be considered submitted to the PDS until the peer review is completed and any liens have been addressed and accepted by the PDS. Depending on the length of the mission there could be a single peer review at the end of the mission, or more likely, a series of peer reviews at regular intervals throughout the life of the mission—typically every three months.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed investigation data archiving plans and budgets must be consistent with the policies and practices of the PDS. For the PDS, guides to the archiving process and tools for data archive preparation may be downloaded from the PDS website (<http://pds.nasa.gov/tools/index.shtml>). Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the PI-Managed Investigation Cost.

Requirement O-24. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving shall be described. The science products (e.g., flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the formats and standards to be used, selected from the published list of approved PDS Standards. It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community. This supersedes Requirement B-21 in Appendix B of the SALMON-2 AO.

4.6 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are specified in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.4.1.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirement and constraints for that specific solicitation, including the sponsoring NASA Headquarters (HQ) mission directorate and division, the type of MO, the cost cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2,

the cost guidelines are discussed in Section 4.4.1, and the schedule constraint is specified in Section 4.4.2.

- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. The NASA Center for program office is specified in Section 2.4. A program-specific safety, reliability, and quality assurance document will be provided after Step-1. The document *Reliability Assurance Requirements (RAR Europa Clipper Mission (ECM))* is provided in the Program Library as an example which proposers may find useful.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the mission category and the payload risk classifications are specified in Section 4.5.6.
- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation in this solicitation. For this PEA, those limitations are specified in Section 4.1
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Investigation Cost and the Total Investigation Cost. For this PEA, that information is specified in Section 4.4.1.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.4.1 and 4.4.2.
- Section 4.6 of the SALMON-2 AO states that each PEA will identify any NASA-provided launch services. For this PEA, NASA plans for access to space are discussed in Section 4.5.4.
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Section 3 that evaluation and selection will be done using a two-step selection process although NASA may choose to condense the process to a single step. Additional details on the implementation of the two-step process can be found on Section 6.3 of this PEA.
- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an E/PO program that is consistent with NASA SMD policy is required. This PEA states that an E/PO program is not required, pending further NASA guidance for E/PO policy, and Requirements 68, 69, and 70 of the SALMON-2 AO do not apply to this PEA. Proposals should not include an E/PO plan or budget. NASA reserves the right to request an E/PO program from the selected investigation(s) at 1% of the proposed PI managed budget, and outside the PI managed budget, pending further guidance on E/PO policy.
- Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA. As indicated in Section 4.4.1.1 of this PEA, no Student Collaboration incentive is offered and the full cost of the Student Collaboration is part of the PI-Managed Investigation Cost.
- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by SMD and it does not permit contributions of funding from NASA SMD programs other than the funding offered through this PEA.

- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection Official. This PEA identifies the Selection Official in Section 6.2.

4.7 Exceptions to General SALMON-2 Requirements

This PEA contains the following exceptions to the SALMON-2 proposal preparation and submission requirements described in the SALMON-2 AO.

- Section 4.4.1.2 supersedes Section 5.5.5 of the SALMON-2 AO
- Requirement O-17 in Section 4.5.4 of this PEA requires the inclusion of a table in the proposal document. As noted in the requirement, this table does not count against the page limits specified in Appendix B of the SALMON-2 AO.
- Section 4.5.8 of this PEA provides data policies and supersedes Section 4.4 of the SALMON-2 AO.
- Proposals shall not include a plan or a budget for science-exploration-technology enhancement options (SEOs); this supersedes Section 5.2.5 of the SALMON-2 AO.
- Section 4.5.7 provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO.
- Section 4.5.1 intends to clarify the requirement for New Technologies and/or Advanced Engineering Developments and supersedes Section 5.3.4 of the SALMON-2 AO.
- Requirement O-26 clarifies the information requested on the traceability of the proposed investigation and supersedes Requirement B-15 of the SALMON-2 AO.
- Requirements O-27 and O-28 clarify the information requested on instrument resource and performance margins and supersede Requirements B-23 and B-24 of the SALMON-2 AO respectively.
- Requirement O-29 clarifies the information requested on new technologies and/or advanced engineering development and supersedes Requirement B-27 of the SALMON-2 AO.

5 PROPOSAL PREPARATION AND SUBMISSION

5.1 Proposal Content Requirements

Requirement O-25. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO.

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA reviewers.

The key data associated with the electronic submission of proposals (see Section 6.2 of the SALMON-2 AO) includes questions indicating whether or not a proposal contains export-controlled information (see Sections 5.9.4 and 5.10.2 of the SALMON-2 AO). All proposers must answer these questions YES or NO when completing the electronic submission; these questions shall not be left unanswered.

All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO. To the extent possible, ITAR sensitive material should be organized into separate clearly marked sections.

Below, requirements B-15, B-23, B-24, and B-27 of Appendix B of the SALMON-2 AO are clarified for this solicitation.

The requirement O-26 clarifies the information requested on the traceability of the proposed investigation, e.g., instrument performance requirements and projected performance estimates. A modified template is available on the Program Library to assist proposers on presentation of the investigation traceability. Requirement O-26 supersedes Requirement B-15 of the SALMON-2 AO.

Requirement O-26. Traceability from science goals to measurement requirements to instrument functional and performance requirements and to top-level investigation requirements shall be provided in tabular form and supported by narrative discussion. Instrument projected performance shall be compared to the instrument performance requirements.

Requirements O-27 and O-28 clarify the information requested on instrument resource and performance margins. Requirement O-27 and O-28 supersedes requirements B-23 and B-24 of the SALMON-2 AO.

Requirement O-27. Instrument Contingencies and Margins: This section shall summarize contingencies and margins of all instrument resources. At a minimum, it shall provide estimates of implementation design margins with respect to the required performance for the following: Mass, Power, Data Storage, and any other resource requirements. For proposals for more than one instrument, the mass, telemetry, and power and reserves and margins must be identified separately for all the necessary components of each instrument in case only an individual instrument is selected from the proposed suite (see SALMON-2 AO for definitions of contingency and margin). Discuss the allocation of contingency and margin to the instrument and/or suite.

Requirement O-28. Performance Margins: For the instrument performance, this section shall provide estimates of performance margin with respect to the performance requirements.

Requirement O-29 clarifies the information requested on new technologies and/or advanced engineering development. Requirement O-29 supersedes requirement B-27 of the SALMON-2 AO.

Requirement O-29. The New Technologies section shall describe any proposed new technologies and/or advanced engineering developments and the approaches that will be taken to reduce associated risks. Descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed system (level 3 WBS payload developments and level 3 WBS spacecraft elements) incorporating new

- technology and/or advanced engineering development at the time the proposal is submitted (for *TRL definitions*, see NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*, Appendix E, in the Program Library);
- Rationale for combining the TRL values of components and subsystems to derive each full system TRL as proposed, appropriately considering TRL states of integration (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*);
 - Rationale for the stated TRL value of an element that is an adaptation of an existing element of known TRL;
 - The approach for maturing each of the proposed systems to a minimum of TRL 6 by PDR:
 - Demonstration (testing) in an operational environment can be accomplished at the system level or at lower level(s);
 - If applicable, justify what demonstration(s) in an operational environment at lower level(s) (subsystem and/or subsystem-to-subsystem) would be sufficient to meet system level TRL 6, considering (i) where any new technology is to be inserted, (ii) the magnitude of engineering development to integrate elements, (iii) any inherent interdependencies between elements (e.g., critical alignments), and/or (iv) the complexity of interfaces – see the Program Library for examples;
 - Include discussion of simulations, prototyping, demonstration in an operational environment, life testing, etc., as appropriate;
 - An estimate of the resources (manpower, cost, and schedule) required to complete the technology and/or advanced engineering development; and
 - Approaches to fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance liens they impose on the baseline design, and the decision milestones for their implementation.

If no new technologies or advanced engineering development is required, system TRL 6 or above at the time of proposal submission shall be clearly demonstrated

5.2 Proposal Submission Requirements

Requirement O-30. Proposals must be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only.

Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement O-31. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

The proposal evaluation process requires evaluators free of Conflict of Interest. In order to assist NASA in the planning of the proposal evaluation process, NASA requires a comprehensive list of proposed investigation participants.

Requirement O-32. With the proposal submission via NSPIRES, the proposers shall identify any institution that is specified in the proposal but that does not appear in either the "Team Member" section (Section VI) of the cover page or in answer to the question about "participants [...] who do not appear on the proposal's cover page." The proposer shall list the institution and division name, role (e.g., solar array provider, instrument component provider), and estimated fixed year dollars to be received. This information will be used to avoid financial and organizational conflicts of interest during the evaluation process by checking evaluators against institutions that are proposed to supply materials, parts, or services.

5.3 Submission of Proposals by Non-U.S. Organizations

In order to be able to submit a proposal to NASA, the PI needs to be "affiliated" with an NSPIRES organization and have an authorizing official from that organization submit the proposal; PIs cannot submit proposals themselves. Because many foreign organizations have not registered in NSPIRES, an organization has been created within NSPIRES that can be used to submit a proposal under the following conditions (which must all be met):

- The proposing organization is a non-U.S. organization. U.S. organizations must be registered in NSPIRES and proposals from U.S. organizations must be submitted by an authorizing official from the proposing organization.
- The proposing organization is not already registered in NSPIRES.
- In lieu of the proposal being submitted by an authorizing official of the proposing organization, the proposal must include a Letter of Submission that is signed by an authorizing official of the proposing organization. The Letter of Submission should be placed following the Fact Sheet and preceding the proposal Table of Contents. The Letter of Submission, if appropriately worded, can also serve the purpose of the letter of financial endorsement referenced in Section 5.10 of the SALMON-2 AO.
- PIs considering taking advantage of this option must notify the NASA contact prior to September 12, 2014.

5.4 Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this appendix, or in the documents available through the Program Library, should be sent to the E-mail address for the point of contact that is listed in Section 7 of this PEA. Responses that are helpful and informative to proposers will be posted on the website also listed in Section 7 of this PEA.

The deadline for receipt of questions is three weeks before the proposal due date listed in Section 7 of this PEA.

6 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

In addition to the evaluation factors given in Section 7.2 of the SALMON-2 AO, the evaluation of implementation merit and feasibility of the instrument investigation also includes the following factors:

- Factor B-2, probability of technical success, also includes the maturity of the design or the demonstration of a clear path to achieve the necessary maturity.

In addition to the evaluation factors given in Section 7.2 of the SALMON-2 AO, the evaluation of the TMC feasibility of the investigation implementation including cost risk also includes the following factors:

- Factor C-4, probability of technical success, also includes the radiation shielding/hardening design and strategy and the associated radiation hardened hardware, as well as the planetary protection strategy.

The panel evaluating the third evaluation criterion, technical, management, and cost (TMC) feasibility of the investigation implementation, including cost risk, may also provide comments to NASA regarding the extent to which the proposed instrument is compatible with potential spacecraft interfaces and operations. These comments will not contribute to the TMC feasibility risk rating.

After the evaluation, but prior to the selection decision, NASA will perform an accommodation study of selectable proposals to assess the extent to which the proposed instrument is compatible with likely platform interfaces and operations. The accommodation assessments will be performed by firewalled members of the Europa Pre-Project Office.

6.2 Selection Process

After the review by the AO Categorization and Steering Committees, the final evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the selections. As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency, including the Director of the Planetary Science Division, concerning the selections.

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among selectable proposals, including, but not limited to, planning and policy considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the mission directorate(s). For this Europa Instrument PEA selection, these factors also include the likelihood that the proposed instrument

can be accommodated on a platform and mission architecture selected by NASA in the near future.

The accommodation assessment to be conducted by firewalled members of the Europa Pre-Project Office will also inform the Selection Official of the technical, implementation, and operational risks associated with the accommodation of individual and combinations of investigations.

As stated in Section 1.1 of this PEA, NASA plans a two-step competitive process. At any time NASA may choose to condense the evaluation and selection process to a single step competitive process, resulting in final selection of investigations for development and flight operations at the end of the first step.

6.3 Implementation Activities

Proposal selection and award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO and Section 7 of this PEA with the following amendments.

6.3.1 Award Administration and Funding of Investigations

Oversight management responsibilities have been assigned to the Discovery/New Frontiers Program Office (D/NF PO) at the NASA Marshall Space Flight Center. The responsibilities of the D/NF PO will include oversight of science instrument development; coordination of Government-furnished services, equipment and facilities, coordination of the selected team with potential platforms for integration; and contract management for selected investigations.

The D/NF PO will authorize the release of funding to each selected investigation. The initiation of the investigation's award of the contract will take place as soon as possible after notification of selection. In order for contracts to be awarded, Statements of Work (SOWs), updated cost and pricing data are required. For reference, a SOW template is available in the Program Library. If more than one contractual arrangement between NASA and the proposing team is required, separate SOWs, updated cost, and pricing data are required for each contractual arrangement. NASA Centers will receive funding via intra-agency funding mechanisms.

Proposals are not required to include SOWs and cost and pricing data. These will be required only for investigations that are selected for award. For those investigations that are selected, it will be in the best interest of the PI-led investigation management teams to provide updated SOWs, cost and pricing data, and small business subcontracting plans in as timely a manner as possible. The process of awarding contracts cannot begin until final SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed. For each selection, and unless otherwise stated in the selection letter, the selected investigation's cost cap will be set at the proposal's proposed cost.

SOWs will be required for selected investigations, regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government

Responsibilities (as applicable). For contracts that exceed \$700K, the contractor will be required to provide cost and pricing data to support the cost estimate and to certify the cost proposed for the contract in accordance with FAR 15.403-4.

In the case of a two-step competitive process, the award of the Phase A concept study is to be initiated as soon as possible after notification of selection. NASA Centers will receive funding via intra agency funding mechanisms. For each Phase A selection, NASA will request Statements of Work (SOWs), cost and pricing data, and small business subcontracting plans. If more than one contractual arrangement between NASA and the proposing team is required, a separate SOW and budget breakdown is required for each organization. For Phase A contracts that exceed \$700K, the contractor will be required to provide cost and pricing data to support the Phase A cost estimate and to certify the cost proposed for the Phase A contract in accordance with FAR 15.406-2. The contractor will also be required to provide cost and pricing data, and a SOW, for a 5 month Phase B bridge option (if applicable).

In the case of a two-step competitive process, SOWs will include the requirement for a Phase A Concept Study Report as described in the Guidelines and Criteria for the Phase A Concept Study document that will be made available in the Program Library, as well as general task statements for Phases B through F. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). SOWs need not be more than a few pages in length.

In the case of a two-step competitive process, each Phase A contract will contain a priced option for a Bridge Phase, to be exercised upon investigations down selected to proceed into Phase B. The Bridge Phase option will allow work to be continued uninterrupted under the contract after a Step-2 downselection decision is made. The Bridge Phase is intended to cover a five month period of effort to provide program continuity while negotiations are completed to modify the contract to include Phases A, B, C/D, and E/F. The Bridge Phase option will be exercised only on the contract for the mission(s) chosen during the Step-2 downselection process to continue beyond the Phase A concept study. Additional phases will be added to the contract after each Phase has been approved through the program review process. The five month Bridge Phase period will be used to begin the negotiation of the remaining phases of the contract with the successful PI downselected following Step 2.

6.3.2 Conduct of the Phase A Concept Study

In a two-step competitive process, the concept studies are intended to provide NASA with more definitive information regarding the cost, risk, and feasibility of the instrument investigations before final selection for implementation. The product of the concept studies is a Phase A Concept Study Report to be delivered by each selected investigation team approximately seven months following the establishment of initial contracts. The content and format of the study reports will be specified in the *Guidelines and Criteria for the Phase A Concept Study* document that will be available in the Program Library. Preferably, NASA will determine the mission architecture and associated platform before the beginning of Step-2. Parameters in this PEA may be updated for the Phase A Concept Study based on NASA programmatic and budgetary decisions. These updates will be clearly communicated with study teams at the start of the Phase A Concept Study and documented in the *Guidelines and Criteria for the Phase A Concept Study*.

These updates may require changes by proposers in selected instrument investigations, and these changes (including changes to schedule and budget) should be incorporated as part of the Phase A Concept Study.

The PI will provide in the Phase A Concept Study Report a proposed set of Level 1 requirements, including the criteria for full investigation success satisfying the Baseline Science Investigation and the criteria for minimum investigation success satisfying the Threshold Science Investigation. The PI will also provide in the Phase A Concept Study Report the allocation of the proposed cost reserves among the appropriate WBS elements. While typically the PI-Managed Investigation Cost may not increase by more than 20% from that in the Step-1 proposal to that in the Phase A Concept Study Report, NASA recognizes that uncertainty exists until a mission architecture is determined by the Agency. The NASA review of the completed Concept Study Report will include all mission facets. Risk reduction that has been accomplished during Phase A will be closely reviewed. NASA may request presentations and/or site visits to review the final concept study results with the investigators.

Each investigation's Concept Study Report must conclude with a commitment by the PI for the cost, schedule, and scientific performance of the investigation. For each investigation selected at the end of Step-2, and unless otherwise stated in the selection letter, the selected investigation's cost cap will be set at the Concept Study Report's proposed cost.

NASA cannot guarantee that the proposed funding profile can be accommodated within the budget. A funding profile for the selected investigation will be negotiated after downselection for subsequent mission phases.

6.3.3 Downselection of Investigations

The SMD Associate Administrator will make downselection decisions based on the evaluation of the Phase A Concept Study Reports and on programmatic considerations. The criteria for evaluating the concept study are as follows:

- Scientific merit of the proposed investigation;
- Science implementation merit and feasibility of the investigation;
- Technical, management, and cost feasibility of the investigation implementation, including cost risk; and
- Quality of plans for small business subcontracting plans and optional student collaboration, if proposed.

The evaluation criteria and downselection factors are described in the *Guidelines and Criteria for the Phase A Concept Study* document that will be available in the Program Library. Any changes to science and science implementation contained in the Phase A Concept Study Report will be carefully evaluated. Assuming no changes to the first criterion, the emphasis during downselection will be on the latter two.

At the conclusion of Step 2, it is anticipated that the Selecting Official will continue approximately eight investigations into the subsequent phases of mission development for flight

and operation. The target date for this continuation decision (i.e. downselection) is given in Section 3.

An investigation may be downselected to enter Phase B or may be downselected for a funded Extended Phase A so they can retire one or more risks before they are allowed to proceed to Phase B. There is no guarantee that an investigation downselected for an Extended Phase A will be approved to enter Phase B, even if all risks have been retired during the Extended Phase A. In no case is NASA required to exercise any option. NASA will not exercise any contract option nor continue funding those investigations not selected to proceed.

Upon a continuation decision, NASA will execute the Bridge Phase option and begin to provide additional funding for the project that is continued beyond the Phase A concept study. During the Bridge Phase, NASA and the continued project will negotiate and sign a contract modification necessary for the remaining portion of mission phases. Deliverables will be negotiated during the Bridge Phase, on the basis of information provided in the Concept Study Report.

In no case is NASA required to exercise any option. NASA will not exercise any contract option nor continue funding those investigations not selected to proceed. For those investigations that are not continued, the contracts will be allowed to terminate without further expense to NASA. Every investigation team will be offered a debriefing of the evaluations of its Concept Study Report.

6.3.4 International Agreements

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, NASA's Office of International and Interagency Relations, Science Division, will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency MOU.

7 SUMMARY OF KEY INFORMATION

Funding available	See Section 4.4.1 of this PEA
Release Date	July 15, 2014
Date for Preproposal Workshop	July TBD, 2014 via remote meeting; see the Europa PEA additional information page at http://soma.larc.nasa.gov/europa/ for time, agenda, and logistical information
Due Date for NOI (notice of intent to propose, encouraged for this solicitation)	11:59 p.m. Eastern Time on August 15, 2014
Due Date for Proposals	11:59 p.m. Eastern Time on October 17, 2014
Web site for additional information for the Europa Instrument PEA	http://soma.larc.nasa.gov/europa/
Library for the Europa Instrument PEA	http://soma.larc.nasa.gov/europa/programLibrary.html
Submission Medium	Electronic copies only; see Section 5.2 of this PEA
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)
NASA point of contact	Dr. Curt Niebur Europa Program Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-0390 E-mail: curt.niebur@nasa.gov

* END OF PEA O *

NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)

NNH12ZDA0060-EVI3
PROGRAM ELEMENT APPENDIX (PEA) P:
EARTH VENTURE INSTRUMENT (EVI)-3

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PROGRAM ELEMENT APPENDIX (PEA) P:
EARTH VENTURE INSTRUMENT-3

1 BACKGROUND

1.1 Programmatic Overview

The National Aeronautics and Space Administration (NASA) Science Mission Directorate (SMD) Earth Science Division's Earth Venture (EV) mission portfolio is an element within the Earth System Science Pathfinder (ESSP) Program. Earth Venture missions consist of a series of regularly solicited, competitively selected, cost and schedule constrained Earth science investigations as recommended by the most recent National Research Council's decadal survey in Earth science, *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (The National Academies Press, 2007), available at http://www.nap.edu/catalog.php?record_id=11820.

The goal of NASA's Earth Venture mission portfolio is to provide frequent flight opportunities for high quality, high value, focused Earth science investigations that can be accomplished under a not-to-exceed cost cap and that can be developed and flown relatively quickly, generally in five years. The investigations will be Principal Investigator (PI) led and will be selected through an open competition to ensure broad community involvement and encourage innovative approaches.

The programmatic objectives of the Earth Venture mission portfolio are to implement missions that will:

- advance scientific knowledge of Earth science processes and systems;
- add scientific data and other knowledge-based products to data archives for all to access;
- result in scientific progress and results published in the peer-reviewed literature to encourage, to the maximum extent possible, the fullest commercial use of the knowledge gained;
- provide opportunities to expand the pool of well-qualified Principal Investigators and Project Managers for implementation of future NASA missions;
- implement technology advancements accomplished through related programs; and
- communicate scientific progress and results through popular media, scholastic curricula, and outreach materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

The EV investigations will accomplish high quality Earth science investigations utilizing efficient management approaches to contain mission cost through commitment to, and control of, design, development, and operations costs.

This solicitation calls for proposals for complete PI-led science investigations requiring spaceflight instrument or CubeSat(s) development. The term "complete" encompasses investigation phases from project initiation, through development and science operations, to

scientific analysis of space based data. These spaceflight missions will be used to conduct innovative, integrated, hypothesis or scientific question-driven investigations addressing pressing Earth system science issues.

This solicitation calls for investigations addressing any of the science goals in NASA's Earth Science program (see Section 2.1 for a description of the science goals). Investigations may target any Earth science question or issue in order to advance the strategic goals outlined in Section 2.1, answer any of the science questions for Earth Science from Section 2.1 of this PEA and the *2014 Science Mission Directorate Science Plan* (hereafter referred to as the *2014 Science Plan*; available at <http://science.nasa.gov/about-us/science-strategy/>), or address any of the science goals for Earth Science also from the *2014 Science Plan*.

Investigations that address NASA goals in other areas such as heliophysics, astrophysics, or planetary science are not solicited in this solicitation. Priority will be given to cost-effective, innovative investigations with demonstrable reliability, rather than ones with excessive technology development requirements. Investigations that focus on establishing entirely new research avenues or demonstrating key applications-oriented measurements are solicited.

A key to the success of the Earth Venture portfolio will be maintaining a steady and predictable stream of opportunities for community participation and innovative idea development. This requires that strict schedule and cost guidelines be enforced on the selected EV missions and mission teams.

1.2 Earth Venture Background

The National Research Council's decadal survey in Earth science recommended that NASA maintain a line of competitively selected, moderate size missions and opportunities in the Earth Venture mission portfolio. Five solicitations/selections have already resulted from the NASA Earth Venture program. Earth Venture is being implemented in the broader context of NASA's Earth Science program and has resulted in more frequent opportunities than afforded by the strategic and directed missions outlined in the decadal survey.

The following foci have been identified for the Earth Venture-class missions:

- measurement and observation innovations;
- demonstration of innovative ideas allowing the use of existing moderately higher-risk technologies or approaches;
- establishment of new research avenues; and
- possible demonstration of key application-oriented measurements.

The selection criteria for EV missions are based primarily on the direct science return from the measurement.

The National Research Council's decadal survey in Earth science and applications has recommended three types of Earth Venture-class missions. Through the Earth Venture mission portfolio, NASA intends to obtain a mix of suborbital, instrument, and complete spaceflight

mission investigations. To achieve this mix, three different kinds of solicitations are being pursued under the Earth Venture-class line.

- *EV Suborbital* (i.e., EVS-1, 2, 3, ...). These solicitations call for proposals for complete suborbital, PI-led investigations to conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The first suborbital science investigations funded under the EV-1 element (or EVS-1 by the new EV naming scheme) are now in operations. Under EVS-2 solicitation, the second one of this series, investigations were selected in November 2014. This is not solicited in this SALMON-2 PEA.
- *EV-Mission* (i.e., EVM-1, 2, 3, ...). These solicitations call for proposals for complete PI-led spaceflight missions to conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The EV-2 (or EVM-1 by the new EV naming scheme) solicitation was the first of this series, with the selected mission now in development. The second solicitation in this series is expected to be released by the middle of 2015. This is not solicited in this SALMON-2 PEA.
- *EV Instrument* (e.g., EVI-1, 2, 3, ...). These solicitations call for developing instruments for participation on a NASA-arranged spaceflight mission of opportunity or for developing CubeSat(s) to fly on a NASA arranged launch vehicle. These investigations must conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The NASA funded PI will retain a central role on the instrument package or CubeSat(s) development, integration and testing, calibration, and science operations. The EVI-1 solicitation was the first of this series, with the selected mission now in development. As a result of the EVI-2 call, two investigations were selected. Solicitations in this series are anticipated every 18 months (or shortly after the selection announcement of the previously solicited EVI). This is solicited in this SALMON-2 PEA.

All Earth Venture-class spaceflight missions require a schedule for launch (or delivery for platform integration in the case of EVI) within five years of project initiation and projects are cost-capped. The Earth Venture class is not intended to be a mechanism for accelerating the implementation of decadal survey missions. However, it is also possible and acceptable that an instrument selected and developed through this solicitation could address significant portions of missions or measurements identified by the decadal survey.

This is the third solicitation in the Earth Venture Instruments series. The fourth solicitation in this series is anticipated to be 18 months after the release of this EVI-3 PEA but not before the selection announcement for EVI-3.

1.3 Overview of this Program Element Appendix

NASA issues this Program Element Appendix (PEA) as an appendix of the Second Stand Alone Missions of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO) for the purpose of soliciting proposals for Mission of Opportunity (MO) investigations to be implemented through the Earth Venture Instrument (EVI) portion of the Earth System Science

Pathfinder (ESSP) Program. All investigations proposed in response to this solicitation must support the goals and objectives of the ESSP Program and the EVI element (Section 2.1) and must be implemented by Principal Investigator (PI) led investigation teams (Section 5.4 of the SALMON-2 AO). Two types of investigations are solicited: Instrument Investigations and CubeSat Investigations.

Instrument Investigations must encompass the provision of a flight qualified spaceflight instrument or instrument package ready for integration to a spacecraft (Phase A-C), the technical support for integration onto a NASA-determined spacecraft (Phase D, see Section 4.4.1), the on-orbit operations, and the delivery of science quality data (Phase E), as described in Section 4.1 of the SALMON-2 AO.

CubeSat Investigations must encompass the provision of CubeSat(s) (instrument and flight systems) ready for integration to the launch vehicle (Phases A-D), the technical support for integration onto a NASA-determined launch vehicle (part of Phase D, see Section 4.4.1), the on-orbit operations, and the delivery of science quality data (Phase E), as described in Section 4.1 of the SALMON-2 AO.

Proposals submitted in response to this SALMON-2 PEA will be evaluated and selected through a single step competitive process. As the outcome of this single step, NASA intends to select at least one proposed investigation to proceed to mission development for flight and operations. If more than one proposal is deemed selectable such that combined costs are within the available funding (as defined in Section 4.4.1), NASA may select more than one investigation in response to this solicitation.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO and this PEA, particularly Section 5.1, contain additional requirements on the format and content of the proposals. Documents available in the EVI-3 Library at http://essp.larc.nasa.gov/EVI-3/evi-3_library.html are intended to provide guidance for proposers; they are specifically not intended to impose requirements on proposals.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 NASA Earth Science Goals

One of NASA's strategic goals is to "Advance understanding of Earth and develop technologies to improve the quality of life on our home planet". Further information on NASA's Strategic Goals may be found in NASA Policy Directive (NPD) 1001.0B, *The 2014 NASA Strategic Plan*, available through the EVI-3 Library. The NASA Science Mission Directorate (SMD) is addressing this strategic goal by pursuing the Earth Science Goals.

Our planet is changing on all spatial and temporal scales and studying the Earth as a complex system is essential to understanding the causes and consequences of climate change and other global environmental concerns. The purpose of NASA's Earth science program is to advance our scientific understanding of Earth as a system and its response to natural and human-induced

changes and to improve our ability to predict climate, weather, and natural hazards.

NASA's ability to observe global change on regional scales and conduct research on the causes and consequences of change position it to address the NASA strategic objective for Earth science, which is to advance knowledge of Earth as a system to meet the challenges of environmental change, and to improve life on our planet. NASA addresses the issues and opportunities of climate change and environmental sensitivity by answering the following key science questions through our Earth science program:

- How is the global Earth system changing?
- What causes these changes in the Earth system?
- How will the Earth system change in the future?
- How can Earth system science provide societal benefit?

These science questions translate into seven overarching science goals to guide the Earth Science Division's selection of investigations and other programmatic decisions:

1. Advance the understanding of changes in the Earth's radiation balance, air quality, and the ozone layer that result from changes in atmospheric composition (*Atmospheric Composition*)
2. Improve the capability to predict weather and extreme weather events (*Weather*)
3. Detect and predict changes in Earth's ecological and chemical cycles, including land cover, biodiversity, and the global carbon cycle (*Carbon Cycle and Ecosystems*)
4. Enable better assessment and management of water quality and quantity to accurately predict how the global water cycle evolves in response to climate change (*Water and Energy Cycle*)
5. Improve the ability to predict climate changes by better understanding the roles and interactions of the ocean, atmosphere, land and ice in the climate system (*Climate Variability and Change*)
6. Characterize the dynamics of Earth's surface and interior, improving the capability to assess and respond to natural hazards and extreme events (*Earth Surface and Interior*)
7. Further the use of Earth system science research to inform decisions and provide benefits to society

Two foundational documents guide the overall approach to the Earth science program: the NRC's 2007 Earth science decadal survey and NASA's 2010 climate-centric architecture plan. The NRC decadal survey articulates the following vision for Earth science research and applications in support of society:

Understanding the complex, changing planet on which we live, how it supports life and how human activities affect its ability to do so in the future is one of the greatest intellectual challenges facing humanity. It is also one of the most important challenges for society as it seeks to achieve prosperity, health, and sustainability.

The 2007 decadal survey recommended a broad portfolio of missions to support the research that

is needed to provide answers to the key science questions and accomplish the related science goals. Recognizing the pressing challenge of climate change, NASA addressed the need to ensure the continuity of key climate monitoring measurements in its 2010 climate-centric architecture plan. The plan reflects the need to collect additional key climate monitoring measurements, which are critical to informing policy and action, and which other agencies and international partners had not planned to continue. The plan also accelerated key decadal survey recommendations to address the nation's climate priorities.

NASA's ability to view the Earth from a global perspective enables it to provide a broad, integrated set of uniformly high-quality data covering all parts of the planet. NASA shares this unique knowledge with the global community, including members of the science, Government, industry, education, and policy-maker communities. For example, NASA plays a leadership role in a range of Federal interagency activities, such as the U.S. Global Change Research Program (USGCRP), by providing global observations, research results, and modeling capabilities. It also maintains an expansive network of partnerships with foreign space agencies and international research organizations to conduct activities ranging from data sharing agreements to joint development of satellite missions. These interagency activities and international partnerships substantially leverage NASA's investments and provide knowledge essential for understanding the causes and consequences of climate change and other global environmental concerns.

Further information on the goals and objectives of NASA's Earth Science program may be found in the *2014 Science Mission Directorate Science Plan* available through the EVI-3 Library.

2.2 Accommodation of EV Instruments and Launch of EV CubeSats

The objective of this solicitation is to select one or more Instrument Investigation(s) where an instrument(s) is built and deployed on an existing or planned spacecraft, and/or one or more CubeSat Investigation(s) where CubeSats are developed and ride to space on an available launch vehicle. Both types of investigations must produce high quality and highly useful Earth Science data. Instrument investigations will be proposed without a firm identification of the spacecraft to accommodate these instruments and CubeSat Investigations will face uncertainty about access to space. Therefore, selection of proposals from this solicitation will take into account the "accommodability" of the proposed instruments and/or the access to space for proposed CubeSats, as well as the value of the science to be returned from the selected investigations.

Many satellites that will be launched to orbits appropriate for observations of the Earth System are expected to have capacity to accommodate Instrument Investigations. These spacecraft could be developed by NASA (including the International Space Station), other U.S. agencies, foreign space agencies, or commercial vendors. In order to take advantage of excess payload capacity on any of these platforms, NASA is planning to have instruments available for inclusion on these various spacecrafts. The available capacity including size, weight, power, thermal control, pointing stability, pointing ability, orbits, and data rates for each potential platform will vary, but in general the platform requirements and capacities will be defined by their primary payloads. The instruments provided through this PEA will have to work within the available resources. Hence, there will be some constraints on the specifications of any instruments potentially selected for development through this EVI-3 PEA. Proposed instruments that cannot meet many

of the requirements anticipated for most potential platforms will be seen as a higher risk for accommodation than those that have higher specification margin.

NASA has initiated a CubeSat Launch Initiative (CSLI) and begun regularly providing launch opportunities for CubeSats as secondary payloads on U.S. Government missions. The CubeSat Launch Initiative is managed by the NASA Human Exploration and Operations Mission Directorate; see http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html.

For further information, please contact:

Anne E. Sweet,
Launch Services Program Executive,
Phone: 202-358-3784,
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or,

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E-mail: jason.c.crusan@nasa.gov

2.3 NASA Management of the Earth Venture Program

The selected investigation(s) will be managed by the Earth System Science Pathfinder (ESSP) Program. The Associate Administrator for NASA SMD has established an ESSP Program Office (ESSP PO) at the NASA Langley Research Center (LaRC) to be responsible for project oversight. The ESSP Program Manager at NASA LaRC reports to the Associate Director for Flight Programs within the Earth Science Division at NASA Headquarters. Additional details about the program office staffing, structure, and management approach can be found in the *ESSP Program Plan*, available through the EVI-3 Library. There are appropriate protective firewalls between the ESSP Program Office and the rest of NASA LaRC, allowing investigators from LaRC to propose in response to this PEA. ESSP PO will manage the EVI investigations under the requirements of NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, as described in Section 4.1.2 of the SALMON-2 AO.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

This solicitation is an appendix to the NASA SALMON-2 AO. The SALMON-2 AO provides the overall structure and guidelines for several types of mission of opportunity solicitations. Each new opportunity is announced with a Program Element Appendix (PEA). This document is such a PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com> and at <http://go.nasa.gov/SALMON2-AO>.

This PEA solicits Earth science investigations that include the development of instruments to be provided to and integrated with yet-to-be-identified space platforms and/or the development of CubeSats to be provided to and integrated with yet-to-be-identified launch vehicles.

Evaluation and selection will be done using a single step selection process; no competitive Phase A (Step 2) or down selection is planned. Normal Phase A activities will be conducted by the selected investigation team or teams following selection.

The following schedule applies to this PEA.

- A Pre-proposal Workshop will take place in association with this solicitation. Further information will be available at the Earth Venture Instrument-3 Acquisition Homepage (see Section 7 of this PEA) prior to the Pre-proposal Workshop.
- Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA. The period for questions will close two weeks before the proposal due date.
- A Notice of Intent (NOI) to propose to this announcement is REQUIRED for this solicitation. It is desired by NASA SMD that all NOIs have the entire investigation team identified within the NOI to allow for the identification of unconflicted evaluators by the proposal due date. SMD requires that proposers communicate any changes to the investigation team between NOI and proposal submission directly to the EVI-3 Program Scientist identified in Section 7 of this PEA. NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Section 6.1.2 of the SALMON-2 AO provides information on electronic NOI submission through NSPIRES. Submitting an NOI does not commit the team to submitting a proposal.
- All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.
- NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four months following receipt of the Statement of Work, as set forth in Section 6.3.1 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Propose

Refer to Section 4.2 of the SALMON-2 AO for the rules on participation policy. For this particular PEA, NASA will place full or partial limitations (as described in the SALMON-2 AO) on organizations that will be involved in the evaluation process. Cornell Technical Services LLC (CTS) is subject to the "Full Limitation" as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on The Aerospace Corporation for EVI-3.

4.2 Type of Mission of Opportunity

In the context of the SALMON-2 AO, this PEA is a Focused Mission of Opportunity (FMO). A FMO is one that addresses a specific, NASA-identified flight opportunity that fulfills the solicited objectives and includes all of the elements specified in this document and in the SALMON-2 AO.

The investigation PI is responsible for conducting the proposed science investigation which includes, but is not limited to: (i) development and delivery of the instrument, instrument

package, and/or CubeSat(s); (ii) working with NASA to integrate the instrument on the NASA-chosen platform and/or the complete CubeSat(s) onto the NASA-determined launch vehicle; (iii) commissioning, validating, and operating the instrument and/or CubeSat(s) on-orbit and required ground systems in order to carry out the proposed science investigation; (iv) preparing and delivering appropriate data analysis software, including required calibration data, analyzing the data, publicly distributing all the proposed investigation data from the prime mission phase to the scientific community, archiving the data in a NASA-chosen Distributed Active Archive Center (DAAC), and reporting the results of the science investigation in the scientific literature.

4.3 Science Requirements and Constraints

The science goals and questions are fully described in Section 2 of this PEA. Any appropriate science question relevant to Earth system science can be addressed with the proposed investigations. Section 2 provides the basis for the evaluation of intrinsic science merit as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside Earth system science as described in Section 2 are not solicited through this call.

Requirement P-1. Proposals shall address appropriate science goals and questions relevant to Earth system science as described in Section 2 of this PEA.

Requirement P-2. Each proposal shall clearly define its science goals and questions, shall demonstrate how the science questions map into high-level science requirements, and shall show how the science requirements subsequently map into the measurement and instrument performance requirements and for CubeSat Investigations into the CubeSat(s) performance requirements.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement P-3. Each proposal shall clearly state the baseline and threshold requirements for the performance of the instrument and/or CubeSat(s), the prime mission lifetime for operations, and range of satellite orbits acceptable or required for deployment.

Requirement P-4. Proposals shall designate all Co-Investigators (Co-Is), describe the role of each Co-I in the development of the mission, and justify the necessary nature of the role; see Section 5.6 of the SALMON-2 AO.

Each observation from space has natural synergies with other observations. Some proposed observations may either require or desire additional observations in order to better address the science questions as proposed for the investigation. Some of these observations may be currently existing or planned either from other NASA missions or from missions by other U.S. or non-U.S. agencies. Proposers are expected to clearly state any dependencies on other data sets, what assumptions are made on the likelihood that these observations will exist during potential time frames for operation of their proposed investigations, and the implications if those observations do not exist.

Requirement P-5. Each proposal shall clearly outline which additional ongoing or planned observations, if any, are required for the proposed investigation to achieve its baseline mission

science investigation. The proposal shall describe how the high-level science requirements will be impacted if such observations do not exist when the proposed investigation is in operation.

Most NASA Earth science observations from space require stringent and well-defined calibration and validation plans. NASA expects each proposal to fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the selected PI-led investigation, the proposal should provide information about the commitment to funding for those data in the time frame of five to ten years after selection of the investigation and describe the implications to meeting the science requirements if such data do not become available.

Requirement P-6. Each proposal shall fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the selected PI led investigation, the proposal should provide information about the expectations for available calibration and validation instruments and/or data in the time frame of five to ten years after selection of the investigation and describe the implications to meeting the science requirements if such activities do not become available.

4.4 Cost and Schedule Requirements and Constraints

4.4.1 Cost Requirements and Constraints

The PI-Managed Mission Cost Cap for an Earth Venture Instrument investigation depends on the instrument class as described in Section 4.5.5 of this PEA. For Class D instrument based investigations or for CubeSat based investigations, the cost cap is \$31M in Fiscal Year (FY) 2018 dollars. For Class C instrument based investigations, the cost cap is \$97M in FY 2018 dollars.

NASA expects to select some combination of Class C and Class D investigations based on funding availability at the time of selection, assuming all such investigations are deemed selectable.

Each selected investigation is PI-Managed, and the PI will be responsible for defining and controlling the costs within the proposed budget for each phase of the investigation. Since NASA will be arranging the spacecraft for the Instrument Investigation(s) and access to space for CubeSats, some costs cannot be defined and controlled by the PI, and these costs will be outside the constrained PI-Managed Mission Cost. This section identifies those costs that are constrained within the PI-Managed Mission Cost and those where NASA requires planning budgets that are outside the constrained PI-Managed Mission Cost. A summary of budgeted costs that are and are not to be included within the PI-Managed cost cap for Instrument Investigations is listed in Table 1 and for CubeSat Investigations is listed in Table 2.

The ESSP Program's planning budget can accommodate one or more selection(s) within this solicitation's cost cap with a typical (combined) funding profile over a nominal five-year development period for instrument delivery. Proposers should propose a funding profile that is appropriate for their investigation. However, NASA cannot guarantee that every proposed funding profile can be accommodated within the ESSP Program's budget. The inability of NASA

to accommodate the requested funding profile may be a reason for nonselection of a proposal. Final funding profiles for all selected investigations will be negotiated between the ESSP Program and the selected investigation teams.

Requirement P-7. Proposals shall be for complete investigations including Phases A-F.

Requirement P-8. The proposed PI-Managed Mission Cost shall be no more than \$97M in FY 2018 dollars for a Class C instrument based investigation. The PI-managed cost shall be no more than \$31M in FY 2018 dollars for any Class D instrument or any CubeSat based investigation. The PI-Managed Mission Cost for Instrument Investigations excludes the integration of the instrument to the selected platform and for CubeSat Investigations excludes the integration of the CubeSat to the selected launch vehicle; it also excludes launch services. All proposals shall include proposed science team, instrument personnel, and key management and engineering staff activity in Phase D. Proposals shall assume two years for Phase D.

Requirement P-9. Proposals shall include detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Mission Cost (see Tables 1 and 2).

4.4.1.1 *Instrument Investigation Cost Requirements and Constraints*

For Instrument Investigations, costs that are within the PI-Managed Mission Cost include: instrument delivery ready for integration onto the selected platform (Phases A-C); development and delivery of functional algorithms and ground processing system (Phases B-D); supporting a science team that will contribute directly to the successful implementation of the investigation (Phases A-F); required calibration and validation activities (Phases C-E); operations, product generation, and data analysis during the proposed prime mission lifetime of the investigation (Phases E); and close out of the investigation once the investigation has been concluded (Phase F). The PI-Managed Mission Cost also includes the cost of the science team and of key management, instrument, and engineering staff during Phase D, as this is not expected to be dependent on the final platform of the selected investigation. For support of the science team and key management and engineering during Phase D, a two-year duration should be assumed for budgeting purposes.

It is expected that once an appropriate platform is determined (preferably before the Preliminary Design Review) minor changes to the selected instrument will be required. Appropriate budget margin should be planned to account for such changes.

Costs that are outside the PI-Managed Mission Cost include integration to the NASA selected platform (Phase D); and investigation costs during any potential gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D).

For planning purposes, the proposal must include estimates of costs for Phase D (nominally two years) that would be outside the PI-Managed Mission Cost as identified above. It is understood that final Phase D cost will be dependent on the selected platform for the instrument and the actual time frame for each development phase.

NASA also requires proposals to include plans and planning budgets that estimate the minimum costs for the project if there is a gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D). These "gap planning" budgets should be on a per-year basis up to a maximum of four years. The costs for both of these planning budgets are outside of the PI-Managed Mission Cost.

Requirement P-10. Instrument Investigation proposals shall include integration plans and planning budgets that occur during Phase D, with the assumption that this phase will take two years. With the exception of the PI-Managed science, management, and engineering cost for Phase D identified in Table 1, these costs are outside the PI-Managed Mission Cost.

Requirement P-11. Instrument Investigation proposals shall include plans and planning budgets for the required costs to minimally support the project and science during a potential gap between instrument delivery (end of Phase C) and the start of integration with the spacecraft (start of Phase D). These budgets should be on a per-year basis for up to four years. These costs are outside the PI-Managed Mission Cost.

Table 1: List of portions of an Instrument Investigation cost that are within and outside the PI-Managed Mission Cost. Budgets for both are required in each proposal.

Portion of the Investigation	Within PI-Managed Mission Costs	Outside PI-Managed Mission Costs
Phase A	X	
Phase B	X	
Phase C	X	
Investigation Costs during a potential gap between completion of instrument and start of integration (planning budget up to four years, on a per-year basis)		X
Science Team activity within Phase D	X	
Key management and engineering staff during Phase D (Project manager, instrument manager, systems engineer, etc.) assuming a two year Phase D	X	
Integration and test to selected platform (within Phase D) (planning budget nominally two years)		X
Cal/Val planning (all phases)	X	
Postlaunch instrument commissioning activity (within Phase D)	X	
Phase E	X	
Phase F	X	
Cost for access to space		X
Education or Communication program, not required, see Section 4.6.		X

Student Collaboration (SC) (optional)	X – any SC cost above 1% of the PI-Managed Mission Cost	X - Up to 1% of the PI-Managed Mission Cost
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4.4.1.2 *CubeSat Investigations Cost Requirements and Constraints*

For CubeSat Investigations, all costs are inside the PI-Managed Mission Cost except the cost associated with integration and launch of the CubeSats on the NASA selected launch vehicle(s), as identified in Table 2. The PI-Managed Mission Cost also includes the cost of the science team and of key management, mission, and engineering staff during the integration and test to selected launch vehicle part of Phase D, as this is not expected to be dependent on the launch services provided to the selected investigation. For support of the science team and key management and engineering during this part of Phase D, a one-year duration should be assumed for budgeting purposes.

Once an appropriate launch vehicle is determined (preferably before the Preliminary Design Review) minor changes to the CubeSat(s) may be required. Appropriate budget margin should be planned to account for such changes.

Costs that are outside the PI-Managed Mission Cost include integration to the NASA selected launch vehicle (part of Phase D); and investigation costs during any potential gap between the delivery of the completed CubeSat(s) (part of Phase D) and the start of integration to the designated launch vehicle (part of Phase D).

For planning purposes, the proposal must include estimates of cost for the part of Phase D (nominally one year) that would be outside the PI-Managed Mission Cost as identified above. It is understood that final Phase D cost will be dependent on the selected launch service and the actual time frame for each development phase.

NASA also requires proposals to include plans and planning budgets that estimate the minimum costs for the project if there is a gap between the delivery of the completed CubeSat(s) (part of Phase D) and the start of integration of the CubeSat(s) to the designated launch vehicle (part of Phase D). These “gap planning” budgets should be on a per-year basis up to a maximum of two years. The costs for both of these planning budgets are outside of the PI-Managed Mission Cost.

Requirement P-12. CubeSat Investigation proposals shall include launch vehicle integration plans and planning budgets that occur during this part of Phase D, with the assumption that this part of Phase D will take one year. With the exception of the PI-Managed science, management, and engineering cost necessary for this portion of Phase D identified in Table 2, these costs are outside the PI-Managed Mission Cost.

Requirement P-13. CubeSat Investigation proposals shall include plans and planning budgets for the required costs to minimally support the project and science during a potential gap between CubeSat delivery (part of Phase D) and the start of integration with the launch vehicle

(part of Phase D). These budgets should be on a per-year basis for up to two years. These costs are outside the PI-Managed Mission Cost.

Table 2: List of portions of a CubeSat Investigation cost that are within and outside the PI-Managed Mission Cost. Budgets for both are required in each proposal.

Portion of the Investigation	Within PI-Managed Mission Costs	Outside PI-Managed Mission Costs
Phase A	X	
Phase B	X	
Phase C	X	
Phase D (integration of instrument(s) to CubeSat(s) and delivery of CubeSat(s) to Launch Services)	X	
Investigation Costs during a potential gap between completion of CubeSat(s) and start of integration to launch vehicle (planning budget up to -two years, on a per-year basis)		X
Science Team activity within Phase D	X	
Key management and engineering staff during integration and test to selected launch vehicle part of Phase D (Project manager, instrument manager, systems engineer, etc.) assuming a one year part of Phase D	X	
Integration and test to selected launch vehicle (within Phase D) (planning budget nominally one year)		X
Cal/Val planning (all phases)	X	
Post-launch instrument commissioning activity (within Phase D)	X	
Phase E	X	
Phase F	X	
Cost for access to space		X
Education or Communication program, not required, see Section 4.6.		X
Student Collaboration (SC) (optional)	X – any SC cost above 1% of the PI-Managed Mission Cost	X - Up to 1% of the PI-Managed Mission Cost

4.4.2 Full Cost Accounting for NASA Facilities and Personnel

This Section supersedes Section 5.5.5 of the SALMON-2 AO.

For the purpose of calculating the full cost of NASA-provided services, proposal budgets from NASA Centers, whether as the proposing organization or as a supporting organization, are to include within the PI-Managed Mission Cost all costs normally funded by an SMD Project under NASA's full cost accounting practices, including civil servant labor (salaries and benefits), civil service travel, and procurements. All of these costs must be clearly identified by year within the budget justification section of the proposal.

Estimated NASA Center Management and Operations (CM&O) overhead costs must also be included within the cost cap, to enable a level playing field for all proposers. Per Headquarters policy guidance signed in June 2010 by the Associate Administrator, Mission Support Directorate and by the Agency Chief Financial Officer, all Centers shall use an identical CM&O burden rate of \$47K (FY 2018) per "equivalent head." Per NASA policy, this rate must be applied as a "cost per equivalent head" to all Civil Service Full Time Equivalents (FTEs) plus on/near site contractor Work Year Equivalents (WYEs) associated with the proposal. The estimated FTEs and WYEs per fiscal year, and the resulting CM&O burden, must be identified in a separate table within the budget justification section of the proposal.

The CM&O burden costs must be clearly denoted in all budget tables. These costs may not be included or rolled into any other budget lines in such a way that they become unidentifiable.

Do not include within the cost proposal, or within the PI-Managed Mission Cost, any estimate for Agency Management and Operations (AM&O, a.k.a. NASA Headquarters overhead).

Table 3: Cost Elements for NASA Center Budget Proposals in response to SMD AOs

	Identify in proposal?	Include in PI-Managed Mission Cost?	Funding source	Comments
Civil Service Labor	Yes	Yes	SMD Program	Includes salaries and benefits
Civil Service Travel	Yes	Yes	SMD Program	
Other Direct/Procurements	Yes	Yes	SMD Program	Includes procurements as typically identified by flight projects in the NASA N2 budget database
CM&O	Yes	Yes	CASP	Applied to NASA provided labor, including Center civil servants and on-site contractors
AM&O	No	No	CASP	
NASA Contributed Costs	Yes	No	Identify	Must be non-SMD
Non-NASA Federal Government (funding requested from NASA)	Yes	Yes	SMD Program	If NASA funding is requested for the non-NASA Federal Government agency
Contributions	Yes	No	Identify	Includes all non-NASA contributions

Requirement P-14. Proposals including costs for NASA Centers shall conform to the full cost policy stated in this Section. Each of the elements of the NASA Center costs (direct labor, travel, and procurements) shall be separately identified by year.

If any NASA funded item(s) or services are to be considered as contributed costs, then the contributed item(s) must be separately funded by a non-SMD effort complementary to the proposed investigation, the value of the contribution(s) must be estimated, and the funding source(s) must be identified.

Requirement P-15. If any NASA funded item(s) or services are considered as contributed costs, then the proposal shall estimate the value of the contribution(s) and shall identify the funding source(s).

Any non-NASA Federal Government costs must follow the appropriate agency accounting standards for full cost. If no standards are in effect, the proposers must follow the *Managerial Cost Accounting Concepts and Standards for the Federal Government*, as recommended by the Federal Accounting Standards Advisory Board and available in the EVI-3 Library.

Requirement P-16. Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

4.4.3 Schedule Requirements and Constraints

Each selected Class C instrument investigation under this EVI solicitation will be expected to deliver an instrument that can be integrated onto a NASA-determined platform by March 31, 2021. Nominally, the selected investigation(s) development Phases A through C will span the years of FY 2016-FY 2021. Proposals that include a more rapid instrument development timelines may be selected, provided the required budget phasing can be accommodated by NASA.

Each selected Class D instrument or CubeSat investigation under this EVI solicitation will be expected to deliver an instrument that can be integrated onto a NASA-determined platform and/or a CubeSat(s) that can be integrated to a NASA-determined launch vehicle by March 31, 2020. Nominally, the selected investigation(s) development Phases A through C (or into Phase D for CubeSats) will span the years of FY 2016-FY 2020. Proposals that include more rapid development timelines may be selected, provided the required budget phasing can be accommodated by NASA.

It is expected that once an appropriate platform and/or launch service is determined by NASA, preferably before the Preliminary Design Review, minor changes to the selected instrument and/or CubeSat(s) will be required. Appropriate schedule margin should be planned to account for such changes.

Requirement P-17. For Class C instrument investigations, proposals shall include a development schedule that delivers an instrument for integration onto the selected platform no later than March 31, 2021. For Class D instrument or CubeSat investigations, proposals shall include a development schedule that delivers an instrument for integration onto the selected platform and/or a CubeSat(s) that can be integrated to a launch vehicle no later than March 31, 2020.

4.5 Technical Requirements and Constraints

4.5.1 *New Technologies/Advanced Engineering Developments*

This section intends to clarify the requirement for New Technologies and/or Advanced Engineering Developments and supersedes Section 5.3.4 of the SALMON-2 AO.

This EVI-3 PEA solicits flight missions, not technology or advanced engineering development projects. Proposed investigations are generally expected to have mature technologies, with systems at a Technology Readiness Level (TRL) of 6 or higher. For the purpose of TRL assessment, systems are defined as level 3 Work Breakdown Structure (WBS) payload developments (i.e., individual instruments) and level 3 WBS spacecraft elements (e.g., electrical power system); see Figure 3-7 of the *NASA WBS Handbook*, NASA/SP-2010-3404, which can be found in the EVI-3 Library. TRLs are defined in NPR 7123.1B *NASA Systems Engineering Processes and Requirements*, Appendix E, which can be found in the EVI-3 Library.

Proposals with a limited number of less mature technologies and/or advanced engineering developments are permitted as long as they contain a plan for maturing systems to TRL 6 (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*) by no later than at Preliminary Design Review (PDR) and adequate backup plans that will provide mitigation in the event that the systems cannot be matured as planned. The TRL state of systems may be validated by an independent team at PDR.

Requirement P-18. Proposals that use systems currently at less than TRL 6 shall include a plan for system maturation to TRL 6 by no later than PDR and a backup plan in the event that the proposed systems cannot be matured as planned (see Section 5.1 of this PEA, for additional detail).

4.5.2 *Instrument Investigation Science Instrument System and Platform Interfaces*

Because there is no defined platform that directly limits the design of the proposed instrument characteristics and observing strategy, this PEA does not list specific requirements or constraints for mass, instrument dimensions, power consumption, data rate, platform stabilization, observational geometry, launch vibration, or desired orbit. However, all of these characteristics must be well characterized and clearly stated within the proposal in order for NASA to determine the feasibility of finding an appropriate platform in the near future to deploy any potential selected instrument.

Instruments that have less stringent and more easily accommodated requirements will be considered more desirable for selection, providing they return high value science, as they are more flexible in being accommodated by the range of potential platforms available in the near future.

Requirement P-19. Proposals for instrument investigations that will be accommodated on a NASA selected platform shall clearly state the proposed instrument mass, volume dimensions, power requirements, platform stabilization requirements, thermal requirements, observational geometry requirements, launch vibration constraints, electromagnetic interference/electromagnetic compatibility (EMI/EMC) requirements, data rate requirements,

and all other requirements (or constraints, preferences, etc.) that the instrument places on the platform for accommodation, launch, deployment, operations, etc. A template is provided on the EVI-3 Library to aid proposers to provide this data. This table shall be provided in the experiment implementation section (Section E) of the proposal. This table does not count towards the proposal page limit.

NASA has been cataloguing the potential platforms that will exist over the next decade with capacity to accommodate a potential EVI Instrument. The goal of this activity is to document, as a service to both NASA and all who are interested in potential integration of instruments on available payloads, the types of opportunities that exist and the current interfaces and constraints that exist for each potential platform. It is also desired that, as much as possible, agreements can be reached as to potential common instrument interfaces for many of these potential platforms. Documentation of this Common Instrument Interface (CII) work is available through links in the EVI-3 Library.

One result of this work is to determine the relative probabilities of NASA identifying a feasible opportunity platform for any potential or proposed EVI instrument. A proposed instrument with a high probability of being compatible with several potential platforms is more likely to be selected than an instrument with less flexible accommodation and orbit requirements (see Section 6.2).

Compared with other candidate platforms, the International Space Station (ISS) may be able to accommodate instruments with higher requirements for mass, volume/dimensions, power, and thermal control. Proposers should state whether the ISS is a potential platform for their instrument and identify the tradeoffs of using the ISS orbit vs. other orbits. Even though NASA has current plans to support ISS operations through 2024, any instrument investigation that is only appropriate for the ISS should describe an adequate timeline of development and operation for the proposed investigation, regardless of whether it is completed by the end of 2024. Differences between the investigation's timeline and NASA's plans for future ISS operations will be factored into the proposal's risk assessment for selection.

Proposals may include information on any research the proposing team has done relative to potential payload accommodations for their proposed instrument. This is not a requirement for any proposal. However, such information can serve to demonstrate to NASA the potential of finding one or more opportunities for accommodating the proposed instrument. If a proposal includes such information, effort should be made to address all known integration criteria and make clear which integration criteria have not been completely researched. Failure to include such research will not be counted against a proposal in evaluation. Inclusion of such information has the potential to support the arguments within a proposal that the instrument has an acceptable chance of being integrated on a platform within an appropriate time frame.

4.5.3 *CubeSat Investigations*

CubeSat proposals are recommended to comply with Cal Poly CubeSat Developer's specifications, found at <http://cubesat.calpoly.edu/index.php/documents/developers>. Concepts that do not comply with the Cal Poly CubeSat and Poly Picosat Orbital Deployer (P-POD) standards should clearly describe how their designs are packaged and deployed. NASA Launch

Services Program has issued a *Program Level Dispenser and CubeSat Requirements Document* with requirements for CubeSats sized up to 6U (2U x 3U). All proposals for CubeSats sized up to 6U shall be compliant with these requirements. Both of these documents can also be found in the EVI-3 Library. No CubeSat form factors larger than 6U will be considered under the present call. Qualifying CubeSat form factors (size) include 1U, 1.5U, 2U, 3U and 6U with a mass not to exceed 1.33 kg per U.

Requirement P-20. All CubeSat proposals shall be compliant with the requirements in the NASA Launch Services Program *Program Level Dispenser and CubeSat Requirements Document*. No CubeSat form factors larger than 6U will be considered under the present call. Qualifying CubeSat form factors (size) include 1U, 1.5U, 2U, 3U and 6U with a mass not to exceed 1.33 kg per U.

4.5.4 Orbit Requirements

Requirement P-21. Proposals shall clearly state the desired and acceptable orbits and operational constraints (e.g., duty cycle or observational cadence) and describe the relative scientific merits of each possible orbit.

4.5.5 Payload Risk Classification

This opportunity solicits proposals for science investigations requiring the development and operation of space-based instrument(s) of either Class C or Class D risk classification (as defined in NPR 8705.4, *Risk Classification for NASA Payloads*; found in the EVI-3 Library). CubeSats are designated as Class D. Section 4.4.1 describes the Cost Caps for Class C vs. Class D investigations.

Requirement P-22. If an investigation requires operation on-orbit for two or more years to meet the science requirements, the proposal must demonstrate how the instrument will meet that time requirement. If any requirements to the instrument that are more stringent than Class C (or Class D, as appropriate for each proposal) are needed, these requirements must be clearly described in the proposal.

4.5.6 End-of-Mission Spacecraft Disposal

Section 5.3.10 of the SALMON-2 AO discusses the requirements related to end-of-mission spacecraft disposal for Partner Missions of Opportunity and hosted payloads where the PI is not responsible for the host mission. For instrument investigation proposals, information shall be included regarding the instrument's plan for passivation at the end of operations or in preparation for end-of-mission disposal. In addition, information shall be provided identifying system components expected to survive Earth reentry as the post-mission disposal method. This will allow NASA to remain in compliance with NPR 8715.6A, *NASA Procedural Requirements for Limiting Orbital Debris*, and NASA-STD-8719.14, *Process for Limiting Orbital Debris*.

Requirement P-23. Instrument investigation proposals shall describe the instrument's passivation plans at end-of-mission and identify components anticipated to survive Earth reentry. This supersedes Requirement 39 in the SALMON-2 AO for instrument investigation proposals. However, Requirement 39 shall be met for CubeSat proposals.

4.5.7 NASA Earth Science Data Policy

4.5.7.1 Data Analysis

The PI will be responsible for production and analysis of the mission data necessary to achieve the proposed science objectives, delivery of products to NASA selected Distributed Active Archive Centers (DAAC), and for timely publication of initial scientific results in refereed scientific journals, as part of their mission operations (Phase E) or post-mission activities. The assigned NASA DAAC(s) will be responsible for archival and public distribution of all data collected by the instrument(s) and produced by the investigations prime measurement phase. The PI is required to work with the DAAC to ensure that the mission data is delivered in a format that meets NASA requirements. The NASA DAAC will not levy any additional cost for its services to the PI, therefore this cost is not to be included as part of the PI Managed Mission Cost. Science studies with the archived data sets beyond the science investigations proposed by the PI-led team will be solicited and selected by NASA in subsequent NASA solicitations through the Research Opportunities in Space and Earth Sciences (ROSES) NASA Research Announcement.

Requirement P-24. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final on-orbit calibration and validation of the measurements. Proposal shall show adequate resources for delivering data products to the assigned NASA DAAC.

Requirement P-25. Proposals shall clearly present a plan for analysis of the mission data leading to completion of the proposed science investigation and achieving the identified investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.5.7.2 Data Rights

By NASA policy, all science data returned from NASA missions are made available immediately in the public domain. Following a post-flight checkout period, all data will be made available to the user community. There shall be no period of exclusive access. The principal investigator shall propose and justify the data product latency period for standard products listed in the proposal, based primarily on the time required to produce, quality-check, and validate the products. Barring exceptional circumstances, data product latency may not exceed six months.

Requirement P-26. Proposals shall include a clear commitment to minimizing the latency for data products. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.5.7.3 Delivery of Data to Archive

During Phase A, NASA will assign a data center, e.g., one of the Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAACs), to be the data archive for the selected mission; proposals should not be tailored to one specific data center. Information on EOSDIS and the DAACs is available at

<https://earthdata.nasa.gov/about-eosdis/science-system-description/eosdis-components>
<https://earthdata.nasa.gov/about-eosdis/science-system-description/eosdis-components/eosdis-data-centers> and
<https://earthdata.nasa.gov/data/standards-and-references>.

Mission data will be made fully available to the public by the investigator team in usable form, in the minimum time necessary and, barring exceptional circumstances, within six months following its collection. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to making it fully available. By no later than the investigation closeout, the investigation will deliver to the NASA-assigned data center all data products, along with the scientific algorithm software, coefficients, ancillary data used to generate these products, and the algorithm and calibration documentation.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in-flight), documentation, related software, and/or other tools or parameters that are necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of the assigned NASA data archive. For information on NASA Earth Science data policy, nomenclature, standards, and EOSDIS, see <http://science.nasa.gov/earth-science/earth-science-data/>. Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the capped PI-Managed Mission Cost.

Requirement P-27. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, metadata generation and delivery to the assigned NASA DAAC for public distribution, and archiving shall be described. The science products (*e.g.*, flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the formats and standards to be used, selected from the published list of approved NASA Earth Science Data System Standards (<https://earthdata.nasa.gov/data/standards-and-references>). It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community. The plan shall conform to the NASA Earth Science Data and Information Policy (see <http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/>). This supersedes Requirement B-21 in Appendix B of the SALMON-2 AO.

4.6 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are specified in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.4.1.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirement and constraints for that specific solicitation, including the sponsoring NASA Headquarters (HQ) mission directorate and division, the type of MO, the cost cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2, the cost cap is specified in Section 4.4.1, and the schedule constraint is specified in Section 4.4.2.
- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. The NASA Center for program office is specified in Section 2.3. There is no program-specific safety, reliability, and quality assurance document.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the payload risk classifications are specified in Section 4.5.5.
- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation in this solicitation. For this PEA, those limitations are specified in Section 4.1
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Mission Cost, the Total Mission Cost, and the Enhanced Mission Cost. For this PEA, that information is specified in Sections 4.4.1 and 4.4.2.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.4.1, 4.4.2 and 4.4.3.
- Section 4.6 of the SALMON-2 AO states that each PEA will identify any NASA-provided launch services. For this PEA, NASA plans for access to space are discussed in Section 2.2, 4.5.2 and 4.5.3.
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Section 3 that evaluation and selection will be done using a single step selection process; no competitive Phase A (Step 2) or down selection is planned.
- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an Education or Communication (previous E/PO) program that is consistent with SMD policy is required.

This PEA states that an Education program is not required. A Communication program may be required, pending further NASA guidance for Communication policy, and those costs will be outside the PI-managed cap. Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA.

- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by NASA SMD and it does not permit contributions of funding from SMD programs other than the funding offered through this PEA.
- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection Official. This PEA identifies the Selection Official in Section 6.2.

4.7 Exceptions to General SALMON-2 Requirements

This PEA contains the following exceptions to the SALMON-2 proposal preparation and submission requirements described in the SALMON-2 AO.

- Proposals or portions of proposals requesting NASA funding shall report proposal costs in Fiscal Year 2018 dollars as well in Real Year (RY) dollars. The former is for determining compliance with the PI-Managed Mission Cost cap requirement. The latter is for NASA SMD budget planning. This instruction supersedes the request for costs only in RY dollars described in Appendix B of the SALMON-2 AO including Table B-3. A modified template of Table B-3 is available on the EVI-3 library.
- Requirement P-19 in Section 4.5.2 of this PEA requires the inclusion of a table in the proposal document. As noted in the requirement, this table does not count against the page limits specified in Appendix B of the SALMON-2 AO.
- Section 4.5.7 of this PEA provides data policies and supersedes Section 4.4 of the SALMON-2 AO.
- Proposals shall not include a plan or a budget for science-exploration-technology enhancement options (SEOs); this supersedes Section 5.2.5 of the SALMON-2 AO.
- Section 4.5.6 provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO.
- Requirement 54 of the SALMON-2 AO limiting incurred costs to no more than 25% of proposed costs by Phase C is waived.
- Section 5.1 provides Proposal Content Requirements; in this section Requirement P-30 supersedes Requirement B-15 of the SALMON-2 AO, Requirement P-31 supersedes Requirement B-23 of the SALMON-2 AO, Requirement P-32 supersedes Requirement B-24 of the SALMON-2 AO, and Requirement P-33 supersedes Requirement B-27 of the SALMON-2 AO.

5 PROPOSAL PREPARATION AND SUBMISSION

5.1 Proposal Content Requirements

Requirement P-28. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO.

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA reviewers.

The key data associated with the electronic submission of proposals (see Section 6.2 of the SALMON-2 AO) includes questions indicating whether or not a proposal contains export-controlled information (see Sections 5.9.4 and 5.10.2 of the SALMON-2 AO). All proposers must answer these questions YES or NO when completing the electronic submission; these questions shall not be left unanswered.

All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO. To the extent possible, International Traffic in Arms Regulation (ITAR) sensitive material should be organized into separate clearly marked sections.

Requirement P-29. All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO.

Below, Requirements B-15, B-23, B-24 and B-27 of Appendix B of the SALMON-2 AO are clarified for this solicitation. All references to "instruments" in this section also apply to CubeSats.

The following Requirement P-30 further clarifies the information requested on the traceability of the proposed investigation and supersedes Requirement B-15 of the SALMON-2 AO. A modified template is available on the EVI-3 Library to assist proposers on presentation of the investigation traceability.

Requirement P-30. Traceability from science goals to measurement requirements to instrument functional and performance requirements and to top-level mission requirements shall be provided in tabular form and supported by narrative discussion. Instrument projected performance shall be compared to the instrument (or CubeSat) performance requirements.

The following Requirement P-31 clarifies the information requested on instrument contingencies and margins and supersedes Requirement B-23 of the SALMON-2 AO.

Requirement P-31. This section shall summarize contingencies and margins of all instrument resources. It shall provide estimates of implementation design margins with respect to the required performance or allocations for mass, power, data storage, and any other resource requirements. For proposals for more than one instrument, the mass, telemetry, and power and contingency and margins must be identified separately for all the necessary components of each instrument in case only an individual instrument is selected from the proposed suite (see SALMON-2 AO for definitions of contingency and margin). Discuss the allocation of contingency and margin to the instrument and/or suite.

The following Requirement P-32 clarifies the information requested on performance margins and supersedes Requirement B-24 of the SALMON-2 AO.

Requirement P-32. For each instrument performance, this section shall provide estimates of performance margin with respect to the performance requirements as compared to projected performance estimates and shall justify that these performance margins are appropriate.

The following Requirement P-33 clarifies the information requested on new technologies and/or advanced engineering developments and supersedes Requirement B-27 of the SALMON-2 AO.

Requirement P-33. This section shall describe any proposed new technologies and/or advanced engineering developments and the approaches that will be taken to reduce associated risks.

Descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed system (level 3 WBS payload developments and level 3 WBS spacecraft elements) incorporating new technology and/or advanced engineering development at the time the proposal is submitted (for *TRL definitions*, see NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*, Appendix E, in the EVI-3 Library);
- Rationale for combining the TRL values of components and subsystems to derive each full system TRL as proposed, appropriately considering TRL states of integration (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*);
- Rationale for the stated TRL value of an element that is an adaptation of an existing element of known TRL;
- The approach for maturing each of the proposed systems to a minimum of TRL 6 by PDR:
 - Demonstration (testing) in a relevant environment can be accomplished at the system level or at lower level(s);
 - If applicable, justify what demonstration(s) in a relevant environment at lower level(s) (subsystem and/or subsystem-to-subsystem) would be sufficient to meet system level TRL 6, considering (i) where any new technology is to be inserted, (ii) the magnitude of engineering development to integrate elements, (iii) any inherent interdependencies between elements (e.g., critical alignments), and/or (iv) the complexity of interfaces – see the EVI-3 Library for examples;
 - Include discussion of simulations, prototyping, demonstration in a relevant environment, life testing, etc., as appropriate;
- An estimate of the resources (manpower, cost, and schedule) required to complete the technology and/or advanced engineering development; and
- Approaches to fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance liens they impose on the baseline design, and the decision milestones for their implementation.

If no new technologies or advanced engineering development is required, system TRL 6 or above at the time of proposal submission shall be clearly demonstrated.

5.2 Proposal Submission Requirements

Requirement P-34. Proposals must be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System

(NSPIRES) at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only.

Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement P-35. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

The proposal evaluation process requires evaluators free of Conflict of Interest. In order to assist NASA in the planning of the proposal evaluation process, NASA requires a comprehensive list of proposed investigation participants.

Requirement P-36. With the proposal submission via NSPIRES, the proposers shall identify any institution that is specified in the proposal but that does not appear in either the "Team Member" section (Section VI) of the cover page or in answer to the question about "participants [...] who do not appear on the proposal's cover page". The proposer shall list the institution and division name, role (e.g., solar array provider, instrument component provider), and estimated fixed year dollars to be received. This information will be used to avoid financial and organizational conflicts of interest during the evaluation process by checking evaluators against institutions that are proposed to supply materials, parts, or services.

5.3 Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this appendix, or in the documents available through the EVI-3 Library, should be sent to the E-mail address for the point of contact that is listed in Section 7 of this PEA. When appropriate, responses will be posted on the website also listed in Section 7 of this PEA.

The deadline for receipt of questions is two weeks before the proposal due date listed in Section 7 of this PEA.

6 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

In addition to the evaluation criteria given in Section 7.2 of the SALMON-2 AO, the evaluation of the Science Merit of the Proposed Investigation also includes the following addition to Factor A-2:

- Factor A-2, programmatic value of the proposed investigation, also includes the extent to which the proposed science investigation addresses unique science areas that are not

being addressed by other missions (both NASA and non-NASA missions) expected to be in operation five to ten years from the start of the proposed investigation.

In addition to the evaluation criteria given in Section 7.2 of the SALMON-2 AO, the evaluation of the Experiment Science Implementation Merit and Feasibility of the Investigation also includes the following additions to Factors B-2 and B-3:

- Factor B-2, probability of technical success, also includes the maturity of the design or the demonstration of a clear path to achieve the necessary maturity.
- Factor B-3, merit of the data and/or sample analysis plan, also includes the quality of the plans for calibration and data archiving, including development of a data pipeline.

The panel evaluating the third evaluation criterion; Technical, Management, and Cost (TMC) Feasibility of the Investigation Implementation, including Cost Risk, will also provide comments to NASA regarding the extent to which the proposed instrument is compatible with potential satellite platform interfaces and operations. These comments will not be considered for the TMC Feasibility of the Investigation Implementation, including Cost Risk evaluation.

After the evaluation, but prior to the selection decision, NASA will perform an accommodation study of selectable instrument investigation proposals to assess the extent to which the proposed instrument is compatible with potential satellite platform interfaces and operations. This accommodation study will also consider the accommodations of selectable CubeSat proposals for launch.

6.2 Selection Process

After the review by the AO Steering Committee, the final evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the selection(s). As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency, including the Director of the Earth Science Division, concerning the selections.

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among selectable proposals, including, but not limited to, planning and policy considerations, available funding and funding profiles, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the Mission Directorate(s). For an EVI proposal selection, these factors also include the likelihood that the proposed instrument can be accommodated on a NASA-selected platform in the near future. For an EVI CubeSat proposal selection, these factors also include that the appropriate launch services can be provided.

6.3 Implementation Activities

Proposal award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO and this section of this PEA with the following amendments.

6.3.1 Award Administration and Funding of Investigations

Oversight management responsibilities have been assigned to the Earth System Science Pathfinder Program Office (ESSP PO) at the NASA Langley Research Center (LaRC). The responsibilities of the ESSP PO will include oversight of the selected investigation(s) development; coordination of Government-furnished services, equipment and facilities, coordination of the selected team with potential platforms for integration; and contract management for selected investigations.

The ESSP PO will authorize the release of funding to each selected investigation. The initiation of the investigation's award of the contract will take place as soon as possible after notification of selection. In order for contracts to be awarded, Statements of Work (SOWs), updated cost and pricing data are required. For reference, a SOW template is available in the EVI-3 Library. If more than one contractual arrangement between NASA and the proposing team is required, separate SOWs, updated cost, and pricing data are required for each contractual arrangement. NASA Centers will receive funding via intra-agency funding mechanisms.

Proposals are not required to include SOWs and cost and pricing data. However, these items will be required for investigations selected for award. The process of awarding contracts cannot begin until final SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed. For each selection, and unless otherwise stated in the selection letter, the selected investigation's Cost Cap will be set at the proposal's proposed cost.

SOWs will be required for selected investigations, regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). For contracts that exceed \$700K, the contractor will be required to provide cost and pricing data to support the cost estimate and to certify the cost proposed for the contract in accordance with FAR 15.403-4.

NASA Centers shall follow their standard operation procedure for selecting teaming partners to facilitate the rapid implementation of their proposal, if selected, and this shall be documented in Appendix 6 of the proposal (see Appendix B, Section J.6, of the SALMON-2 AO).

6.3.2 International Agreements

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, NASA's Office of International and Interagency Relations, Science Division, will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency Memorandum of Understanding (MOU). For additional policies and requirements, see Section 5.9 of the SALMON-2 AO.

7 SUMMARY OF KEY INFORMATION

Funding available	See Section 4.4.1 of this PEA
PEA Release Date	March 25, 2015
Date for Pre-proposal Workshop	April 14, 2015 via Webex; see the EVI-3 Acquisition Homepage at http://essp.larc.nasa.gov/EVI-3/ for time, agenda, and logistical information
Due Date for NOI (notice of intent to propose, required for this solicitation)	11:59 pm eastern time on April 30, 2015
Last Date for submission of Questions	11:59 pm eastern time on June 12, 2015
Due Date for Proposals	11:59 pm eastern time on June 26, 2015
EVI-3 Acquisition Homepage (for additional information on the EVI-3 PEA)	http://essp.larc.nasa.gov/EVI-3/
Library for the EVI-3 PEA	http://essp.larc.nasa.gov/EVI-3/evi-3_library.html
Submission Medium	Electronic copies only; see Section 5.2 of this PEA
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)
NASA point of contact	Dr. Thomas Wagner Earth Venture Instrument-3 Program Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-4682 E-mail: thomas.wagner@nasa.gov

END OF PEA P

NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)
NNH12ZDA0060-HPEXMO
PROGRAM ELEMENT APPENDIX (PEA) Q
HELIOPHYSICS EXPLORERS MISSION OF OPPORTUNITY

On or about July 20, 2016, NASA amended this Announcement of Opportunity as follows:

The date of the Preproposal Conference has been changed to August 15, 2016. The deadline for the submission of a Notice of Intent to (NOI) propose has been changed to August 19, 2016.

Note the Deadline for Proposal Submission has not changed from October 14, 2016. Also note more information about the Preproposal Conference will be posted on the Heliophysics Explorer Acquisition Homepage at <http://explorers.larc.nasa.gov/HPSMEX>.

NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)
NNH12ZDA0060-HPEXMO
PROGRAM ELEMENT APPENDIX (PEA) Q
HELIOPHYSICS EXPLORERS MISSION OF OPPORTUNITY

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SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)

NNH12ZDA0060-HPEXMO
PROGRAM ELEMENT APPENDIX (PEA) Q:
HELIOPHYSICS EXPLORERS MISSION OF OPPORTUNITY

1 BACKGROUND

1.1 Programmatic Overview

The National Aeronautics and Space Administration (NASA) issues this Second Stand Alone Missions of Opportunity Notice (SALMON-2) Program Element Appendix (PEA) for the purpose of soliciting proposals for Heliophysics Mission of Opportunity (MO) science investigations to be implemented through its Explorers Program.

Two Mission of Opportunity types may be proposed in response to this PEA: (1) Partner Missions of Opportunity (PMOs), which may include CubeSats, and (2) Small Complete Missions (SCMs). SCMs include International Space Station (ISS) payloads, commercial hosted payloads, CubeSats or suborbital class (high-altitude scientific balloon missions (Super Pressure Balloon (SPB), Long-Duration Balloon (LDB), or Suborbital Reusable Launch Vehicle (sRLV)), investigations – see Section 4.5.1 and Requirement Q-13). A third type of investigation, U.S. Participating Investigators (USPIs), may be proposed in response to Appendix B.10, Heliophysics Explorer U.S. Participating Investigator, of the NASA Research Announcement, Research Opportunities in Space and Earth Sciences 2016 (ROSES-2016), which is being released simultaneously with this PEA.

Investigations may target any heliophysics scientific investigation that advances the objectives outlined in Section 2.1 of this PEA. Investigations that address NASA goals in other areas, such as astrophysics, Earth science, or planetary science, are not solicited.

1.2 Explorers Program Background

The Explorers Program is the oldest continuous program in NASA. It is comprised of a longstanding series of space science missions that are independent, but share a common funding and NASA oversight/insight management structure. Initiated with the Explorer 1 launch in 1958 and including the Nobel Prize recognized Cosmic Background Explorer (COBE) mission, the Explorers Program has launched over 90 missions.

Though historically not always this way, the program currently administers only Principal Investigator (PI)-led science investigations for the Heliophysics and Astrophysics Divisions of NASA's Science Mission Directorate (SMD). Competitive selection by peer review ensures that the best and most current science affordable within the Cost Cap will be accomplished.

Since the early 1990s, the Explorers Program has provided several types of flight opportunities for addressing heliophysics and astrophysics science objectives. These mission types are defined by their Cost Caps and are designed to increase the number of flight opportunities in response to

recommendations from the scientific community. The ss Program currently consists of two types: larger stand-alone “full missions,” for which NASA offers a dedicated launch vehicle, and smaller investigations called “missions of opportunity.”

An Explorer MO is an investigation generally characterized by being part of a host space mission other than a strategic SMD mission, or by being a small complete mission with its own identified access to space, or by being a new science investigation utilizing an existing operating spacecraft that has completed its prime mission. For each Explorer AO, full mission or MO, the budget available varies, as do the types of investigations that may be proposed.

Explorer MOs are solicited through the SALMON-2 AO (NNH12ZDA006O) by amending it with a specific Program Element Appendix. This solicitation for Heliophysics Explorers Mission of Opportunity is one such PEA.

1.3 Overview of this Program Element Appendix

The SALMON-2 AO is an omnibus solicitation that provides the overall structure, guidelines and requirements for several types of MO solicitations. Each new opportunity is announced through a PEA that details the solicitation and may include additional guidelines and requirements. This document is one such PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/> or at <http://go.nasa.gov/SALMON2-AO>.

NASA issues this PEA as an appendix of the SALMON-2 AO for the purpose of soliciting proposals for Heliophysics Explorer MO investigations to be managed under the NASA Explorers Program. All investigations proposed in response to this solicitation must support NASA’s heliophysics science goals (Section 2.1 of this PEA) and the goals and objectives of the Explorers Program (Section 2.2 of this PEA), must be implemented by Principal Investigator (PI)-led investigation teams (Sections 4.2.4 and 5.4.1 of the SALMON-2 AO), and must result in the provision of complete space investigations (Section 5.3.2 of the SALMON-2 AO).

Proposals submitted in response to this PEA will be selected for flight nominally through a two-step competitive process. Proposals submitted in response to this PEA will undergo the first step evaluation. As the outcome of the first step evaluation, NASA intends to fund one or more MO investigations to proceed to a eleven month Phase A concept study. In the second step, NASA will conduct an evaluation of the Phase A concept study reports. From this evaluation, NASA expects to select one or two MOs to proceed into Phase B and subsequent mission phases.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO contains additional requirements on the format and content of the proposals. Documents available through the Heliophysics Explorers Mission of Opportunity Program Library at <http://explorers.larc.nasa.gov/HPSMEX/MO/programlibrary.html> (hereafter referred to as the Program Library) are intended to provide guidance for investigations selected; they are specifically not intended to impose requirements on proposals.

1.4 NASA Online Document Information System

NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents are available through the NASA On-line Document Information System (NODIS) at <http://nodis3.gsfc.nasa.gov/>.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 NASA Heliophysics Science Objective and Goals

One of NASA's strategic objectives is to understand the Sun and its interactions with Earth and the solar system, including space weather. Further information on NASA's strategic goals may be found in NASA Policy Directive (NPD) 1001.0B, *NASA 2014 Strategic Plan*, available through the Program Library (Appendix D).

The NASA Science Mission Directorate (SMD) is addressing this strategic objective by conducting Heliophysics investigations designed to address the following science goals:

- Explore the physical processes in the space environment from the Sun to the Earth and throughout the solar system
- Advance our understanding of the connections that link the Sun, the Earth, planetary space environments, and the outer reaches of our solar system
- Develop the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth

Further information on the goals and objectives of NASA's Heliophysics program may be found in the *2014 Science Plan for NASA's Science Mission Directorate and Our Dynamic Space Environment: Heliophysics Science and Technology Roadmap for 2014-2033* available through the Program Library.

2.2 Explorers Program Goals and Objectives

The goal of NASA's Explorers Program is to provide frequent flight opportunities for high quality, high value, focused heliophysics science investigations that can be accomplished under a not-to-exceed Cost Cap and that can be developed relatively quickly, generally in 36 months or less, and executed on-orbit in less than three years.

The Explorers Program accomplishes these world-class space science investigations utilizing efficient management approaches to contain mission cost through commitment to, and control of, design, development, and operations costs.

The Explorers Program provides an effective means of timely achievement of strategic goals. By conducting a rapid series of science investigations, NASA is responsive to new knowledge, technology, and science priorities. Pressing questions in heliophysics science are addressed, permitting a steady improvement in our understanding of space science systems and the processes that affect them. The frequent, steady nature of the investigations ensures a continuing

stream of fresh scientific data to the broader science community, thus maintaining the excellence of the U.S. space science program and the inspiration of a new generation of investigators.

The Explorers Program strives to:

- advance scientific knowledge of heliophysics processes and systems;
- add scientific data and other knowledge-based products to data archives for all scientists to access;
- lead to scientific progress and the publishing of results in the peer-reviewed literature to encourage, to the maximum extent possible, the fullest commercial use of the knowledge gained;
- implement technology advancements prepared in related programs; and
- announce scientific progress and results in popular media, scholastic curricula, and materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

2.3 NASA Management of the Explorers Program

The selected investigation(s) will be managed by the Explorers Program. The Associate Administrator for SMD has established the Explorers Program Office at the NASA Goddard Space Flight Center (GSFC) to be responsible for project oversight. The Explorers Program Manager at NASA GSFC reports to the Heliophysics Division Director at NASA Headquarters. Additional details about the program office staffing, structure, and goals can be found in the *Explorers Program Plan*, available through the Program Library. There are appropriate protective firewalls between the Explorers Program Office and the rest of NASA GSFC, allowing investigators from GSFC to propose in response to this PEA. The Explorers Program Office will manage the Heliophysics Explorers Mission of Opportunity investigations under the requirements of NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, as described in Section 4.1.2 of the SALMON-2 AO. Safety, reliability, and mission assurance requirements for Heliophysics Explorers Mission of Opportunity investigations will be consistent with the EXP-RQMT-0003, Small EXplorers (SMEX) Mission Assurance Requirements (MAR) Mission Risk Classification – NPR 7120.5 Class D document found in the Program Library.

All references to NPR 7120.5D NID in SALMON-2 should be interpreted as referencing NPR 7120.5E.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

This solicitation is an appendix to the NASA SALMON-2 AO. The SALMON-2 AO provides the overall structure and guidelines for several types of mission of opportunity solicitations. Each new opportunity is announced with a Program Element Appendix (PEA). This document is such a PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com> and at <http://go.nasa.gov/SALMON2-AO>

The following schedule applies to this PEA.

- A Preproposal teleconference/webex will take place in association with this solicitation. Further information will be available at the Heliophysics Explorer Mission of Opportunity Acquisition website (<http://explorers.larc.nasa.gov/HPSMEX/MO/index.html>) prior to the Preproposal teleconference/webex.

Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA. The period for questions will close two weeks before the proposal due date. Answers will be provided no later than 10 days before the proposal due date.

- A Notice of Intent (NOI) to propose to this announcement is extremely valuable to NASA for purposes of planning the proposal evaluation and peer reviews, and, therefore, is strongly encouraged. NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Section 6.1.2 of the SALMON-2 AO provides information on electronic NOI submission through NSPIRES. Submitting an NOI does not commit the team to submitting a proposal.
- All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.
- Evaluation and selection for flight will be done using a two-step selection process.
- NASA funded Phase A activities will be conducted by the investigation team(s) selected as a result of the first step of this solicitation.
- NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four weeks following receipt of the Statement of Work, as set forth in Section 6.3.2 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Participate in this Proposal Opportunity

Refer to Section 4.2 of the SALMON-2 AO for the policies on participation policy. For this particular PEA, NASA will place full or partial limitations (as described in the SALMON-2 AO) on organizations that will be involved in the evaluation process. Cornell Technical Services LLC is subject to the “Full Limitation” as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on the Aerospace Corporation.

4.1.1 NASA Center Role in Communications and Outreach

Each flight mission must utilize the communications office of a NASA center or JPL to manage the communications plan and activities. Missions managed by a NASA center or JPL will assign the management role to that center’s communications office. For missions not managed by a NASA center or institution, the center where the program office resides will fill the communications management role.

These communications offices will be responsible for leading, coordinating, and executing mission communications activities -- in coordination with the PI -- and with approval of Headquarters SMD and Office of Communications.

NASA’s Principal Investigators (PIs) fill a challenging, multidisciplinary role, which demands excellent communication, team building, and management skills. The PI is a key spokesperson

for the mission – along with NASA officials -- and is integral in communicating mission updates, science, and new discoveries.

The PI provides content, analysis, and context for communication campaigns and news stories. In keeping with NASA's communications goals, this content should convey an understanding of the mission, its objectives and benefits to target audiences, the public, and other stakeholders.

The PI will coordinate with the designated NASA center communications office for all mission-related communications activities. The PI, or his or her designee, shall review all news releases issued for the mission. In case of incompatible views, NASA will have final decision on release of public products, while ensuring that scientific and technical information remains accurate and unfiltered.

Selected PIs also must work with NASA to ensure their mission website follows NASA requirements for providing content on the agency's primary public website at <http://www.nasa.gov/>. NASA, and through NASA the selected investigation, is required under the Information Quality Act (44 U.S.C. 3504(d)(1) and 3516) and associated guidelines to maximize the quality, objectivity, utility, and integrity of information and services provided to the public.

A Communications and Outreach program (previously referred as Public Outreach) is required for this solicitation. Mission-related communications are funded directly through the NASA center and are not within the PI-Managed Mission Cost. The communications plan must be developed during Phase B of the mission. The plan must include topline messaging, target audiences, and media processes linked to reaching target audiences and associated detailed budgets, milestones, metrics and timelines, and reporting requirements.

4.2 Types of Mission of Opportunity

Two Mission of Opportunity (MO) types may be proposed in response to this solicitation: (1) Partner Missions of Opportunity (PMOs), which may include CubeSats, and (2) Small Complete Missions (SCMs). SCMs are ISS payloads, commercial hosted payloads, CubeSats or suborbital class (Super Pressure Balloon (SPB), Long Duration Balloon (LDB) or Suborbital Reusable Launch Vehicle (sRLV)) investigations. See Section 5.1 of the SALMON-2 AO for complete descriptions of these types of MOs as well as constraints and requirements for proposals.

A third type of investigation, U.S. Participating Investigators (USPIs), may be proposed in response to ROSES-16 Appendix B.10. A USPI proposes to participate as a Co-I for an instrument, experiment, or technology demonstration that is being built and flown by a sponsor agency other than NASA. NASA will release a solicitation for Heliophysics Explorers U.S. Participating Investigators through the ROSES-2016 NASA Research Announcement (NRA) (NNH16ZDA001N) simultaneously with this PEA. The Explorers USPI program element appendix of the ROSES NRA is available at <http://nspires.nasaprs.com/> or at <http://solicitation.nasaprs.com/ROSES2016>. USPI proposals submitted to that solicitation will be due at the same time as the Heliophysics Explorers MOs. USPI NOIs and proposals will be submitted in response to the ROSES-2016 amendment, will be subject to the proposal guidelines specified in ROSES-2016, will be subject to the constraints (cost, schedule, technical) and

requirements specified in ROSES-2016, and will be reviewed and selected using the proposal criteria specified in ROSES-2016.

4.3 Science Requirements and Constraints

The science objectives are described in Section 2 of this PEA. Any appropriate science question relevant to NASA's heliophysics objectives and goals may be addressed with the proposed investigations. Section 2 of this PEA provides the basis for the evaluation of intrinsic science merit as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside heliophysics science objectives, as described in Section 2 of this PEA, are not solicited.

Requirement Q-1. Proposals shall address appropriate science questions relevant to the NASA heliophysics science objectives and goals described in Section 2 of this PEA.

Requirements for documentation in the proposal of the flow-down of requirements from the proposed science goals and objectives are described in Section 5.2.2 of the SALMON-2 AO.

Requirement Q-2. Each proposal shall clearly define its science question or questions, shall demonstrate how the science questions map into high-level science requirements, and shall show how the science requirements subsequently map into measurement, data, instrument, and mission requirements.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement Q-3. Each proposal shall clearly state the baseline and threshold requirements for the mission and the baseline and threshold mission lifetime.

Requirement Q-4 supersedes Requirement 19 of the SALMON-2 AO regarding Science Enhancement Option costs.

Requirement Q-4. If SEO activities are proposed, the proposal shall define and describe the proposed activities.

A Co-Investigator (Co-I) is defined as an investigator who plays a necessary role in the proposed investigation and whose services are either funded by NASA or are contributed by his/her employer.

Every Co-I must have a role that is required for the successful implementation of the mission, and the necessity of that role must be justified. The identification of any unjustified Co-Is may result in the downgrading of an investigation and/or the offer of only a partial selection by NASA.

Requirement Q-5. Proposals shall designate all Co-Investigators (Co-Is), describe the role of each Co-I in the development of the mission, and justify the necessary nature of the role; see Section 5.6 of the SALMON-2 AO.

A collaborator is an individual who is less critical to the successful development of the mission than a Co-I. A collaborator must not be funded through the proposal. A collaborator may be committed to provide a focused contribution to the project for a specific task, such as data analysis. If funding support is requested in the proposal for an individual, that individual must not be identified as a collaborator, but must be identified as a Co-Investigator or another category of team member.

Requirement Q-6 and Requirement Q-7 supersede Requirement 67 of the SALMON-2 AO regarding Collaborators.

Requirement Q-6. Proposals shall identify and designate all collaborators, describe the role of each collaborator in the development of the mission, and justify the necessary nature of the role.

Requirement Q-7. Proposals shall identify the funding source for each collaborator; the costs shall be included in the Total Mission Cost.

Each observation from space has natural synergies with other observations. Some proposed observations may either require or desire additional observations in order to better address the science questions as proposed for the investigation. Some of these observations may be currently existing or planned either from other NASA missions or from missions by other U.S. or non-U.S. agencies. Proposers are expected to clearly state any dependencies on other data sets, what assumptions are made on the likelihood that these observations will exist during potential time frames for operation of their proposed investigations, and the implications if those observations do not exist.

NASA expects each proposal to fully describe the requirements for calibration and validation of the instruments and the data returned. Other data policies and requirements are given in Section 4.4 of the SALMON-2 AO and Section 4.6.7 of this PEA.

Requirement Q-8. Each proposal shall fully describe the requirements for calibration and validation of the instruments and the data returned.

4.4 Telecommunications, Tracking, and Navigation

This section provides addition information for section 5.3.6 of the SALMON-2 AO.

It is SMD policy that only one DSN 34 meter antenna will be scheduled at the same time during normal operations of the selected Heliophysics Explorer mission. It is SMD policy that none of the DSN 70 meter antennas may be proposed to support normal operations of the selected Heliophysics Explorer mission. These restrictions do not apply to station hand-offs, critical event coverage, emergency services, radio science measurements, or navigation observations (*e.g.*, delta differential one-way ranging or delta-DOR).

NASA intends to transition all space missions to the use of Ka-band for science data return

(telemetry, tracking, and commanding (TT&C) data may still be transmitted using X-band or S-Band). In order to better manage the Agency's transition to Ka-band service, proposed investigations are required to baseline the use of Ka-band for science data return, unless it is inappropriate.

Radio frequency spectrum for telecommunications is allocated by service (e.g., Earth Exploration-Satellite, Space Research, and Space Research (Deep Space)) and may be further constrained by maximum channel bandwidth limits (see the *Available Spectrum and Channel Limits By Allocated Service* document in the Program Library). Proposals are required to address conformance to applicable maximum channel bandwidth limit(s).

Requirement Q-9. Proposals shall baseline the use of Ka-band for science data return, unless it is inappropriate for the proposed investigation; proposal of an alternative communications approach shall be justified.

Requirement Q-10. Proposals shall address conformance to applicable maximum channel bandwidth limit(s).

Requirement Q-11. Proposals that propose the use of the DSN shall baseline the use of only one DSN 34 meter at any time for normal operations (not including periods of station hand-off).

4.5 Cost and Schedule Requirements and Constraints

4.5.1. Cost Requirements and Constraints

The PI-Managed Mission Cost is defined in Section 4.3.1 of the SALMON-2 AO. Except for suborbital-class missions (high-altitude scientific balloon missions and missions on sRLVs), the PI-Managed Mission Cost Cap for an Heliophysics Explorers Mission of Opportunity, including all mission phases and the cost of accommodation on and/or delivery to the host mission, if applicable, is \$55 million in Fiscal Year (FY) 2017 dollars. The PI-Managed Mission Cost Cap is \$35 million in FY 2017 dollars for suborbital-class missions.

NASA expects to select one or two Heliophysics Explorers Missions of Opportunity. If multiple selectable missions are proposed with combined costs within the available funding, anticipated to be approximately \$55 million, NASA may select more than one proposed investigation.

Each selected investigation is PI-Managed, and the PI will be responsible for defining and controlling the costs within the proposed budget for each phase of the investigation. Costs associated with NASA provided access to space or suborbital access for CubeSats that use CubeSat Launch Initiative (CSLI), suborbital-class missions, and investigations requiring flight to the ISS, will be outside the PI-Managed Mission Cost.

Final funding profiles (Phases A-F) for all selected investigations will be negotiated between the Explorers Program and the selected investigation teams. The inability of NASA to accommodate the requested funding profile may be a reason for nonselection of a proposal.

Requirement Q-12. Proposals shall be for complete investigations including Phases A-F.

Requirement Q-13. The proposed PI-Managed Mission Cost for the Heliophysics Explorers Missions of Opportunity shall be no more than \$55 million in FY 2017 dollars, except for suborbital-class missions (defined as (a) Super Pressure Balloon (SPB) or Long Duration Balloon (LDB) missions and (b) missions on Suborbital Reusable Launch Vehicle (sRLV), for which it shall be no more than \$35 million in FY 2017 dollars.

Requirement Q-14. Proposals shall include detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Mission Cost.

Requirement Q-15 supersedes Requirement 57 of the SALMON-2 AO regarding unencumbered reserves.

Requirement Q-15. Proposals shall justify the adequacy of the proposed cost reserves. Proposals shall include a minimum of 25% of unencumbered cost reserves against the cost to complete and shall demonstrate an approach to maintaining required unencumbered cost reserves through subsequent development phases.

4.5.2. Schedule Requirements and Constraints

For PMOs, the proposing PI must provide evidence that the sponsoring organization intends to fund the primary host mission and that the NASA commitment for U.S. participation is required by the sponsoring organization prior to March 2020. The launch date itself for a PMO is not constrained.

For Small Complete Mission (SCM) MOs, proposers must specify the launch readiness date in the proposal, which is to be no later than August 2022. Explorer SCM MO investigations with an anticipated launch readiness date requirement later than August 2022 should be proposed in response to a subsequent opportunity.

Proposers should be aware that it may be necessary for NASA to adjust the launch date and definition phasing of selected investigations from that proposed in order to conform to the available Explorers Program budget profile and/or NASA's ability to negotiate a launch opportunity to the International Space Station, for a high-altitude scientific balloon mission, for launch opportunities on reusable launch vehicles, or for CubeSat launches; therefore, the degree of launch date flexibility must be indicated in the proposal.

It is intended that proposed investigations be evaluated and selected through a two-step competitive process. Step 1 is the solicitation, submission, evaluation, and selection of proposals prepared in response to this PEA. The Step 1 evaluation and selection process is described in section 7 of the SALMON-2 AO. As the outcome of Step 1, one or more Step 1 proposals may be selected for Phase A study and evaluation if their perceived value to the Explorers Program is significant. NASA will issue awards (provide funding to NASA Centers and the Jet Propulsion Laboratory (JPL), award contracts to non-NASA institutions, or utilize other funding mechanisms, as applicable) to the selected proposers to conduct Phase A concept studies and submit Concept Study Reports to NASA. Step 2 is the preparation, submission, evaluation, and

continuation decision (downselection) of the Concept Study Reports. As the outcome of Step 2, NASA may continue one or more investigations into the subsequent phases of mission development for flight and operations.

Proposers selected through this AO will be awarded a contract to conduct a Phase A concept study with duration of approximately eleven months and capped at \$400,000 Fiscal Year (FY) 2017 dollars.

A proposal may be selected for development without first completing a Phase A concept study. The proposal must make the case that it is not only necessary, but also that it is also technically feasible for the project to be selected for development without a competitive Phase A concept study. The proposer must recognize that NASA would only make such a decision without a Phase A competition if the MO proposal were especially compelling.

Requirement Q-16. Proposals shall include a detailed development schedule (including integration plans) and an associated cost that for a SCM with a launch readiness date no later than August 2022, or for PMOs is consistent with the documented launch and operations schedule of the primary host mission.

Note, for balloon missions planned for launch from Antarctica during the December 2022 - January 2023 campaign, "launch readiness" per this requirement is considered to be one and the same as being at the Columbia Scientific Balloon Facility (CSBF) and ready to complete pre-deployment integration and testing with the CSBF support systems. June is the normal month for pre-deployment integration and testing at the CSBF for Antarctic balloon missions, which in the case of this MO, must be no later than August 2022.

4.5.3. Access to Space Cost Requirements

The following classes of platforms are provided by NASA for access to space, or near space, at no cost to the PI-Managed Mission Cost (see Section 4.6.5 of this PEA for additional information).

- Access to space will be provided by NASA for missions on the International Space Station (ISS).
- NASA will provide balloon vehicles and balloon launch services for missions on high-altitude scientific balloons.
- Platforms are provided by NASA to host payloads on sRLVs.
- NASA will provide launch and deployment services for missions on CubeSats that utilize the CubeSat Launch Initiative (CSLI).

For all other proposals, including small complete missions launched as secondary or hosted payloads, any costs for access to space must be included in the PI-Managed Mission Cost.

Requirement Q-17. With the exception of small complete missions to the International Space Station, missions utilizing the CubeSat Launch Initiative or suborbital-class missions, any costs for access to space must be included in the PI-Managed Mission Cost.

4.5.4. Full Cost Accounting for NASA Facilities and Personnel

This Section supersedes Section 5.5.5 of the SALMON-2 AO.

For the purpose of calculating the full cost of NASA-provided services, proposal budgets from NASA Centers, whether as the proposing organization or as a supporting organization, are to include within the PI-Managed Mission Cost all costs normally funded by an SMD Project under NASA's full cost accounting practices, including civil servant labor (salaries and benefits), civil service travel, and procurements. All of these costs must be clearly identified by year within the budget justification section of the proposal.

Estimated NASA Center Management and Operations (CM&O) overhead costs must also be included within the Cost Cap, to enable a level playing field for all proposers. Per HQ policy guidance signed in June 2010 by the Associate Administrator, Mission Support Directorate and by the Agency Chief Financial Officer, all Centers shall use an identical CM&O burden rate of \$45K (FY2017) per "equivalent head." For years after FY2017, this number must be inflated. Per Agency policy, this rate must be applied as a "cost per equivalent head" to all Civil Service FTEs plus on/near site contractor WYEs associated with the proposal. The estimated FTEs and WYEs per fiscal year, and the resulting CM&O burden, must be identified in a separate table within the budget justification section of the proposal.

The CM&O burden costs must be clearly denoted in all budget tables. These costs may not be included or rolled into any other budget lines in such a way that they become unidentifiable.

Do not include within the cost proposal, or within the PI-Managed Mission Cost, any estimate for Agency Management and Operations (AM&O, a.k.a. NASA Headquarters overhead).

Table 1: Cost Elements for NASA Center Budget Proposals in response to SMD AOs

	Identify in proposal?	Include in PI-Managed mission cost?	Funding source	Comments
Civil Service Labor	Yes	Yes	SMD Program	Includes salaries and benefits
Civil Service Travel	Yes	Yes	SMD Program	
Other Direct/Procurements	Yes	Yes	SMD Program	Includes procurements as typically identified by flight projects in the NASA N2 budget database
CM&O	Yes	Yes	CASP	Applied to NASA provided labor, including Center civil servants and on-site contractors
AM&O	No	No	CASP	
NASA Contributed Costs	Yes	No	Identify	Must be non-SMD
Non-NASA Federal Government (funding requested from NASA)	Yes	Yes	SMD Program	If NASA funding is requested for the non-NASA Federal Government agency
Contributions	Yes	No	Identify	Includes all non-NASA contributions

Requirement Q-18. Proposals including costs for NASA Centers shall conform to the full cost policy stated in this Section. Each of the elements of the NASA Center costs (direct labor, travel, procurements) shall be separately identified by year.

If any NASA funded item(s) or services are to be considered as contributed costs, then the contributed item(s) must be separately funded by a non-SMD effort complementary to the proposed investigation, the value of the contribution(s) must be estimated, and the funding source(s) must be identified.

Requirement Q-19. If any NASA funded item(s) or services are considered as contributed costs, then the proposal shall estimate the value of the contribution(s) and shall identify the funding source(s).

Any non-NASA Federal Government costs must follow the appropriate agency accounting standards for full cost. If no standards are in effect, the proposers must follow the *Managerial Cost Accounting Concepts and Standards for the Federal Government*, as recommended by the Federal Accounting Standards Advisory Board and available in the Program Library.

Requirement Q-20. Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

4.6 Technical Requirements and Constraints

4.6.1 *New Technologies/Advanced Engineering Development*

This Section intends to clarify the requirement for New Technologies and/or Advanced Engineering Developments and supersedes Section 5.3.4 of the SALMON-2 AO.

This PEA solicits PMOs, and SCMs for flight missions, not technology or advanced engineering development projects. Proposed investigations are generally expected to have mature technologies, with systems at a Technology Readiness Level (TRL) of 6 or higher. TRLs are defined in NPR 7123.1B *NASA Systems Engineering Processes and Requirements*, Appendix E, which can be found in the Program Library.

Proposals with a limited number of less mature technologies and/or advanced engineering developments are permitted as long as they contain a plan for maturing systems to TRL 6 (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*) by no later than Preliminary Design Review (PDR) and adequate backup plans that will provide mitigation in the event that the systems cannot be matured as planned. The TRL state of systems will be validated by an independent team at PDR.

Requirement Q-21. Proposals that use systems currently at less than TRL 6 shall include a plan for system maturation to TRL 6 by no later than PDR and a backup plan in the event that the proposed systems cannot be matured as planned (see Section 5.1 of this PEA, for additional detail).

4.6.2 *Additional Requirements for Alternative Access to Space*

The following requirements are in addition to those given in section 4.6.2 *Alternative Access to Space* of the SALMON-2 AO.

The stability and reliability of the proposed relationship with the host organization will be assessed as a programmatic risk element in the proposal.

Requirement Q-22. For proposed secondary or co-manifested missions, or for missions proposed as hosted payloads, the PI assumes all risk for any delays in the implementation of the parent mission and shall, therefore, propose appropriate reserves for such schedule contingencies. Proposal shall include 9 months funded schedule reserve for this risk.

Requirement Q-23. Proposals that include non-NASA launch services (purchased or contributed) obtained from a U.S. or non-U.S. partner shall meet the following requirements:

The proposal must describe the arrangement between the PI and the non-NASA launch service provider to enable the PI's insight for launch services, consistent with NASA Procedural Documents (NPD) 8610.7 and 8610.23. Note that these NPDs allow unique

arrangements for payloads able to tolerate more risk. NASA will develop an advisory approach based on the insight the PI is provided from the non-NASA launch service provider. The proposal budget must include \$2.0M for the NASA launch vehicle monitoring functions and advisory services that would enable NASA to review and advise the PI on launch vehicle information from the non-NASA launch service provider.

Requirement Q-24. Proposals that include payload accommodation as a hosted payload shall meet the following requirements:

The proposed Heliophysics Explorer investigation must be self-sufficient (with exception of any critical resources provided by the host platform) and the success of the Heliophysics Explorer investigation must not depend on the other science payloads accommodated on the host platform. The NASA PI is responsible for the entire Heliophysics Explorer investigation including mission assurance. The proposal shall describe how mission assurance will be met for those areas that are not under the PI's control.

4.6.3 Additional Requirements for Partner Mission of Opportunity Investigations

The following requirements are in addition to those given in Section 5.1.1 of the SALMON-2 AO.

Requirement Q-25. In addition to the requirements given in the SALMON-2 AO, all proposed PMO investigations must also demonstrate: (1) their formal relationship with the sponsoring agency's host mission (e.g., already selected contribution, invited contribution, or proposed contribution); and (2) the status of the host mission within the sponsoring agency (i.e., Pre-Phase A, Phase A, or Phase B), including the level of commitment that the sponsoring agency has made to complete the mission.

Requirement Q-26. In addition to the requirements given in the SALMON-2 AO, all proposed PMO investigations requiring flight on the ISS must also provide a Letter of ISS Technical Interface and Resource Accommodation Feasibility Assessment from the NASA Space Station Research Integration Office demonstrating that the proposed payload to be flown aboard the ISS can meet the access and accommodation requirements for ISS payloads. This ISS Letter of Feasibility Assessment must contain: (1) a preliminary assessment of the feasibility of proposed provisions for access to and accommodation on the ISS, (2) identification of known technical interface challenges and/or conditional provisions for access or accommodation, and (3) a description of the level of technical interchange and negotiation required to mature the proposed provisions for access and accommodation.

Proposers requiring an ISS Letter of Technical Interface and Resource Accommodation Feasibility Assessment should contact:

Dr. George C. Nelson
ISS Research Integration Office/Mail Stop OZ
Johnson Space Center
National Aeronautics and Space Administration

Houston, TX 77058
Telephone: 281-244-8518
E-mail: george.nelson-1@nasa.gov

Please note, the issuance of the ISS Letter of Technical Interface and Resource Accommodation Feasibility Assessment can take several weeks, therefore proposers are urged to contact the ISS Research Integration Office as early as possible for such request.

Additional information is found through the International Space Station Capabilities and Payload Accommodations Document link in the Program Library. For any selected investigations, flight commitment to the ISS will be negotiated with NASA's Human Exploration and Operations Mission Directorate during Phase A. Selection of any investigation to be flown aboard the ISS is conditional until negotiations for ISS access and accommodation are successfully completed.

A Heliophysics Explorer MO investigation that is a PMO to the International Space Station should plan to complete its primary mission investigations by the end of FY 2024. NASA currently plans to operate ISS thru FY 2024, and while the agency is taking no action that would preclude operation beyond FY 2024, no commitment has yet been made either way.

PMOs may be proposed for participation in nonstrategic NASA missions. A PMO may be proposed for participation in a PI-led NASA mission from a program other than Explorer (an Explorer MO may not be proposed for an Explorer mission).

Requirement Q-27. A proposal for a PMO hosted by a PI-led mission from a program other than the Explorers Program must satisfy the following requirements: (1) The proposal must include a Letter of Commitment from the PI of the host mission endorsing the partnership and (2) the feasibility assessment of the host mission, i.e., the technical, management, and cost (TMC) evaluation in Step 1 and Step 2, must include the accommodations for the proposed PMO instrument.

4.6.4 Additional Requirements for Small Complete Mission of Opportunity Investigations

The following requirements are in addition to those given in Section 5.1.3 of the SALMON-2 AO.

Requirement Q-28. In addition to the requirements given in the SALMON-2 AO, all proposed SCM investigations, with the exception of investigations requiring flight on the ISS or suborbital-class missions, or launch services purchased directly by the investigation, must also provide a Letter of Commitment from the program or agency providing access to space. This Letter of Commitment must contain: (1) a detailed description of the proposed provisions for access to space (e. g., launch to orbit provided by industrial or non-U.S. partner, secondary ride on another U.S. sponsored mission, etc.), and (2) the status of those proposed flight provisions within the sponsoring program or agency (i.e., conditional, confirmed, conceptual, etc.) including the level of commitment that the sponsoring program/agency has made to support that flight opportunity.

4.6.4.1 Investigations Hosted on the ISS

SCMs may be proposed for the ISS. Investigations requiring flight on the ISS must provide a Letter of ISS Technical Interface and Resource Accommodation Feasibility Assessment from the NASA Space Station Research Integration Office.

Requirement Q-29. In addition to the requirements given in the SALMON-2 AO, all proposed SCM investigations requiring flight on the ISS must also provide a Letter of ISS Technical Interface and Resource Accommodation Feasibility Assessment from the NASA Space Station Research Integration Office demonstrating that the proposed payload to be flown aboard the ISS can meet the access and accommodation requirements for ISS payloads. This ISS Letter of Feasibility Assessment must contain: (1) a preliminary assessment of the feasibility of proposed provisions for access to and accommodation on the ISS, (2) identification of known technical interface challenges and/or conditional provisions for access or accommodation, and (3) a description of the level of technical interchange and negotiation required to mature the proposed provisions for access and accommodation.

Proposers requiring an ISS Letter of Technical Interface and Resource Accommodation Feasibility Assessment should contact:

Dr. George C. Nelson
ISS Research Integration Office/Mail Stop OZ
Johnson Space Center
National Aeronautics and Space Administration
Houston, TX 77058
Telephone: 281-244-8518
E-mail: george.nelson-1@nasa.gov

Please note, the issuance of the ISS Letter of Technical Interface and Resource Accommodation Feasibility Assessment can take several weeks, therefore proposers are urged to contact the ISS Research Integration Office as early as possible for such request.

Additional information is found through the International Space Station Capabilities and Payload Accommodations Document link in the Program Library. For any selected investigations, flight commitment to the ISS will be negotiated with NASA's Human Exploration and Operations Mission Directorate during Phase A. Selection of any investigation to be flown aboard the ISS is conditional until negotiations for ISS access and accommodation are successfully completed.

A Heliophysics Explorer MO investigation that is a SCM to the International Space Station should plan to complete its primary mission investigations by the end of FY 2024. NASA currently plans to operate ISS thru FY 2024, and while the agency is taking no action that would preclude operation beyond FY 2024, no commitment has yet been made either way.

4.6.4.2 Investigations on High-Altitude Scientific Balloons

SCMs may be proposed for flight on high-altitude scientific balloons. SCMs on high-altitude scientific balloons must be proposed for flight on Long Duration Balloons (LDBs) or Super Pressure Balloons (SPBs).

Requirement Q-30. Proposals for SCM investigations on high-altitude scientific balloons must be proposed for flight on Long Duration Balloons (LDBs) or Super Pressure Balloons (SPBs).

Investigations requiring flight on LDBs or SPBs must provide a Letter of Feasibility from the NASA Balloon Program Office.

Requirement Q-31. In addition to the requirements given in the SALMON-2 AO, all SCM investigations requiring flight on high-altitude scientific balloons must also provide a Letter of Feasibility from the NASA Balloon Program Office demonstrating that the proposed payload to be flown aboard LDBs or SPBs can meet the access and accommodation requirements for balloon payloads. This Letter of Feasibility must contain: (1) a preliminary assessment of the feasibility of proposed provisions for access to and accommodation on LDBs or SPBs, (2) identification of known challenges and/or conditional provisions for access or accommodation, and (3) a description of the level of technical interchange and negotiation required to mature the proposed provisions for access and accommodation.

Proposers requiring a NASA Balloon Program Office Letter of Feasibility should contact:

Debora Fairbrother
National Aeronautics and Space Administration
Balloon Program Office/Code 820
Wallops Flight Facility
Wallops Island, VA 23337
Telephone: 757-824-1453
E-mail: debora.a.fairbrother@nasa.gov

Additional information is found through the *Scientific Balloon Missions of Opportunity* document link in the Program Library. For any selected investigations, flight commitment to LDBs or SPBs will be negotiated with the NASA Balloon Program Office during Phase A. Selection of any investigation to be flown aboard LDBs or SPBs is conditional until negotiations for access and accommodation are successfully completed.

4.6.4.3 Investigations Hosted on CubeSats

SCMs may be proposed for flight on CubeSats. NASA has initiated a CubeSat Launch Initiative (CSLI) and begun regularly providing launch opportunities for CubeSats as secondary payloads on U.S. Government missions. The CubeSat Launch Initiative (CSLI) is managed by the NASA Human Exploration and Operations Mission Directorate. See http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html.

NASA also plans to provide micro/small satellite class payload launch services for CubeSats as primary launches. If NASA provides launch services for a CubeSat investigation as a primary launch, there will be a \$20M charge to the PI-Managed Mission Cost as given in Section 4.5.1. The \$20M charge is only applicable to launch services for no more than a total of 50kg (inclusive of any project deployment hardware).

For CubeSat proposals that use the CSLI, all instruments/small satellites are recommended to comply with Cal Poly CubeSat Developer's specifications, found at <http://www.cubesat.org/resources>. Concepts that do not comply with the Cal Poly CubeSat and Poly Picosat Orbital Deployer (P-POD) standards should clearly describe how their designs are packaged and deployed. NASA Launch Services Program has issued a *Program Level Dispenser and CubeSat Requirements Document* with requirements for CubeSats sized up to 6U (2U x 3U). All proposals that use the CSLI for CubeSats sized up to 6U shall be compliant with these requirements. Both of these documents can also be found in the Program Library. No CubeSat that uses the CSLI form factors larger than 6U will be considered under the present call. CSLI qualifying CubeSat form factors (size) include 1U, 1.5U, 2U, 3U and 6U. The mass limitation is dependent on the launch and dispenser used.

Requirement Q-32. All proposals that use the CSLI involving sizes 1U through 6U CubeSats shall be compliant with the requirements in the NASA Launch Services Program *Program Level Dispenser and CubeSat Requirements Document*. No CubeSat form factors larger than 6U will be considered for use with CSLI. CSLI qualifying CubeSat form factors (size) include 1U, 1.5U, 2U, 3U and 6U. The mass limitation is dependent on the launch and dispenser used. The 1.33 kg/U is the most constraining limit and good for any scenario. The most constraining scenario is for a CubeSat secondary launch opportunity with a NASA science primary, in which case the 1.33 kg/U would apply. However, for CubeSats on a Venture Class Launch Services mission or other government launch, CSLI is accepting CubeSat masses that exceed the 1.33 Kg/U limit. For a 6U CubeSat, 12kg is good limit to use that will satisfy any dispenser on CSLI contract.

For further information, please contact:

Anne E. Sweet,
Launch Services Program Executive,
Phone: 202-358-3784,
E-mail: anne.sweet-1@nasa.gov

or

Jason C Crusan,
Director, Advanced Exploration Systems
Phone: 202-358-0635,
E-mail: jason.crusan@nasa.gov

4.6.4.4 Investigations on suborbital Reusable Launch Vehicles

SCMs may be proposed for flight on suborbital Reusable Launch Vehicles (sRLVs). Access to sRLV platforms is managed by the Flight Opportunities Program within the Space Technology Mission Directorate. Information about sRLVs is available from the Flight Opportunities

Program website at <http://flightopportunities.nasa.gov>. Additional information on sRLV vehicles, including general vehicle capabilities and contact information for some vendors, is available at <http://flightopportunities.nasa.gov/platforms>. The Flight Opportunities Program may advise proposers on the use of sRLV platforms, including the potential integration, safety and mission assurance, and operational costs. Proposers interested in using sRLVs must identify a vehicle that can provide the technical capabilities required to conduct the proposed investigation. SCMs to be flown on sRLVs must either be automated or remotely operated. Remote operation capability must be confirmed with the flight operator.

Requirement Q-33. Proposals for investigations using sRLVs as platforms must specify the technical requirements that their investigation places on the vehicle. The proposal must include a Letter of Endorsement from a commercial vendor that (i) provides technical information on how the vehicle will meet the investigation requirements, (ii) states that the vehicle will be available for use at the time proposed for flight and provides information showing a plan for getting from the current vehicle status to flight status, and (iii) provides a quoted cost for the flight and all other services that are required from the vehicle vendor to enable and conduct the proposed investigation. Note that the Flight Opportunities Program is available to assist with (i) – (iii).

Questions concerning potential sRLV investigations may be addressed to:

LK Kubendran
Flight Opportunities
Space Technology Mission Directorate
NASA Headquarters
Washington, DC 20546
Telephone: 202-358-2528
E-mail: lk@nasa.gov

4.6.5 Risk Classification

This opportunity solicits proposals for science investigations requiring the development and operation of space-based investigations. The projects are designated as Category 3 as defined in NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*. The payloads are designated as Class D as defined in NPR 8705.4, Risk Classification for NASA Payloads, except for PMOs, which depend on host mission's risk classification requirements.

Requirement Q-34 supersedes Requirement B-47 of the SALMON-2 AO and clarifies the information requested on project risks and project resiliency.

Requirement Q-34. This section shall describe the project risks and project resiliency considering these risks.

- Provide the top risks considered significant by the PI and the PM, especially technical risks and risks associated with contributed hardware (if any), and potential mitigation strategies and associated schedule impacts. If resources for these risks have been included in the basis of estimate, indicate so. Alternatively, reserves held to account for these risks

shall be encumbered. If cost risks are in this list, they should be described here and then discussed in Section H (see Requirement B-52 of the SALMON-2 AO).

- The approach to any potential descopes, including savings of resources (mass, power, dollars, schedule, etc.) by implementing descopes, the decision milestone(s) for implementing descopes, and the scientific impact of individual as well as combined descopes shall be discussed.

4.6.6 NASA Science Data Policy

4.6.6.1 Data Analysis

The PI will be responsible for production and analysis of the investigation data necessary to achieve the proposed science objectives, for archiving the data in the relevant NASA heliophysics data archive for public use, and for timely publication of initial scientific results in refereed scientific journals, as part of their mission operations (Phase E) or post-mission (Phase F) activities. Proposals must allocate sufficient resources for this data analysis and archiving. Science studies with the archived data sets beyond the PI-led teams proposed science investigation will be solicited and selected by NASA in subsequent NASA solicitations through ROSES NRAs.

Requirement Q-35. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final on-orbit calibration and validation of the measurements. In accordance with the SMD requirement for open data and related software, any specialized software and algorithms required for basic data analysis and processing will be made available by the PI to the science community and public.

Requirement Q-36. Proposals shall clearly present a plan for analysis of the mission data leading to completion of the proposed science investigation and achieving the identified investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.6.6.2 Data Rights

By NASA policy, all science data returned from NASA investigations led by a NASA-funded PI are made available immediately in the public domain. Following a post-flight checkout period, all data will be made available to the user community. There shall be no period of exclusive access. The principal investigator will propose the data product latency period for standard products listed in the proposal, and a justification for it must be demonstrated. Barring exceptional circumstances, data product latency may not exceed six months.

Requirement Q-37. Proposals shall include a clear commitment to minimizing the latency for data products. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.6.6.3 Delivery of Data to Archive

Mission data will be made fully available to the public by the investigator team in usable form, in the minimum time necessary and, in any case, within the proposed data latency period not to exceed six months following data receipt from the spacecraft. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to making it fully available. By the investigation closeout, the investigation will deliver to the appropriate heliophysics data center all final data products, along with the scientific algorithm software, coefficients, ancillary data used to generate these products, and the algorithm and calibration documentation.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in flight), documentation, related software, and/or other tools or parameters that are necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large and provided within the proposed data latency period not to exceed six months following data receipt from the spacecraft.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of the appropriate NASA data archive.

Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the capped PI-Managed Investigation Cost.

4.6.6.4 Sharing of Data from Partner Mission of Opportunity Investigations

The data that are returned from Partner Mission of Opportunity (PMO) investigations, at least from those aspects of the mission in which NASA is involved, shall be made available to the U.S. scientific community in a timely manner.

Requirement Q-38. In addition to the requirements given in the SALMON-2 AO, all proposed PMO investigations must also provide: (1) a detailed description of the proposed provisions for sharing of science data, plans for returned scientific data, at least from those aspects of the mission in which NASA is involved, shall be made available to the U.S. scientific community in a timely manner, and the status of the host mission sponsoring agency's commitment to enter into an appropriate agreement with NASA for data sharing; and (2) a detailed explanation of how the U.S. heliophysics science community benefits from the proposed investigation.

4.7 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are referenced in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.5.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirements and constraints for that specific solicitation, including the sponsoring NASA Headquarters (HQ) mission directorate and division, the type of MO, the Cost Cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2, the Cost Cap is specified in Section 4.5.1, and the schedule constraint is specified in Section 4.5.2.
- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. For this PEA, the NASA Center for program office and the safety, reliability, and quality assurance document applicable to selected investigations are specified in Section 2.3.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the payload risk classification is specified in Section 4.6.5.
- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation by Aerospace in proposals. For this PEA, Section 4.1 states that there are no additional restrictions on participation by Aerospace in proposals.
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Mission Cost, the Total Mission Cost, and the Enhanced Mission Cost. For this PEA, that information is specified in Section 4.5.1. Only the PI-Managed Mission Cost is capped.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.5.1 and 4.5.2.
- Section 4.6 of the SALMON-2 AO states that each PEA will identify any NASA-provided launch services. For this PEA, NASA plans for access to space are discussed in Section 4.5.3.
- Section 5.2.5 of the SALMON-2 AO describes Science Enhancement Options (SEOs) for proposed investigations. SEOs are permitted for proposals in response to the PEA. Any SEO proposal must meet the requirements in Section 5.2.5 of the SALMON-2 AO except for the cost deletion in the SALMON-2 AO Requirement 19. (See Requirement Q-4).
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Sections 1.3 and 3 that a two-step competitive process is being used.
- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an Education and Public Outreach program that is consistent with SMD policy is required. This PEA does not require an Education and Communications program; therefore Requirements 69 and 70 of

the SALMON-2 AO do not apply to this PEA. However, NASA may impose Education and Communications requirements during or subsequent to the Phase A concept study phase.

- Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA.
- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by SMD and it does not permit contributions of funding from SMD programs other than the funding offered through this PEA.
- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection Official. This PEA identifies the Selection Official in Section 6.2.

4.8 Exceptions to General SALMON-2 Requirements

This PEA contains the following exceptions to the SALMON-2 proposal preparation and submission requirements described in the SALMON-2 AO.

- Proposals or portions of proposals requesting NASA funding shall report proposal costs in FY 2017 dollars for determining compliance with the PI-Managed Mission Cost Cap requirement (see Table B-3b as shown in the Program Library). This instruction supersedes the request for costs in RY dollars described in Appendix B of the SALMON-2 AO.
- Section 4.1.1 supersedes Section 4.1.3 of the SALMON-2 AO.
- Section 4.5.4 supersedes Section 5.5.5 of the SALMON-2 AO.
- Section 4.6.7 of this PEA provides data policies and requirements that supersede those in Section 4.4 of the SALMON-2 AO.
- This PEA does not require an Education and Public Outreach program.
- Requirement Q-6 and Requirement Q-7 supersede Requirement 67 of the SALMON-2 AO regarding Collaborators.
- Requirement Q-9, Requirement Q-10 and Requirement Q-11 are addition requirements to section 5.3.6 of the SALMON-2 AO for Telecommunications, Tracking, and Navigation information.
- Requirement Q-15 supersedes Requirement 57 of the SALMON-2 AO regarding unencumbered reserves.
- Requirement Q-34 supersedes Requirement B-47 of the SALMON-2 AO and clarifies the information requested on project risks and project resiliency.
- Requirement Q-41 supersedes Requirement B-4 of the SALMON-2 AO and clarifies the information requested on page limits.
- The Heritage Appendix shall be limited to 30 pages. This supersedes page B-2 of the SALMON-2 AO.
- The ‘Discussion of End-of-Mission Spacecraft Disposal’ requirements are deleted. This supersedes page B-2 of the SALMON-2 AO.
- Requirement Q-46 clarifies the intent of Requirement 89 and B-57 of the SALMON-2 AO.
- Requirement Q-46 supersedes Requirement B-57 of the SALMON-2 AO regarding Appendices.
- Requirement Q-47 further clarifies proposal heritage claims presented in Requirement B-70 of the SALMON-2 AO

- Section 4.5.1 *Independent Verification and Validation* of the SALMON-2 AO is deferred for this Step One of the Two Step proposal process.
- Section 4.5.4 *Conjunction Assessment of Risk* of the SALMON-2 AO is deferred for this Step One of the Two Step proposal process.
- Section 5.3.10 *End-of-Mission Spacecraft Disposal* of the SALMON-2 AO is deferred for this Step One of the Two Step proposal process. ‘Discussion of End-of-Mission Spacecraft Disposal Requirements’ listed in the *Proposed Structure and Page Limits* on Page B-2 of the SALMON-2 AO is deferred.
- Requirement B-21 of the SALMON-2 AO regarding a schedule-based end-to-end data management plan is deferred for this Step One of the Two Step proposal process.

5. PROPOSAL PREPARATION AND SUBMISSION

5.1. Proposal Content Requirements

Requirement Q-39. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO.

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA reviewers.

The key data associated with the electronic submission of proposals (see Section 6.2 of the SALMON-2 AO) includes questions indicating whether or not a proposal contains export-controlled information (see Sections 5.9.4 and 5.10.2 of the SALMON-2 AO). All proposers must answer these questions YES or NO when completing the electronic submission; these questions shall not be left unanswered.

All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO. To the extent possible, ITAR sensitive material should be organized into separate clearly marked sections.

Requirement Q-40. All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO.

The following Requirement supersedes Requirement B-4 of the SALMON-2 AO and clarifies the information requested on page limits.

Requirement Q-41. Proposals shall conform to the page limits specified in the *Proposal Structure and Page Limits* table. Two extra pages each are allotted for each additional separate, nonidentical science instrument in the Science Sections (Sections D and E), and two extra pages each are allotted for each additional separate, nonidentical flight element (*e.g.*, additional spacecraft are allotted two extra pages, but only nonidentical spacecraft) in the Mission Implementation and Management Sections (Sections F and G), and two extra pages are allotted for all science enhancement options (SEOs) combined, if they are permitted by the AO, in the Science Implementation Section (Section E). Different

instruments on identical spacecraft buses will only be allotted extra pages for additional nonidentical science instruments; no extra pages will be allotted for additional nonidentical flight elements. The total number of such extra pages in the Science and Mission Implementation sections combined shall not exceed a maximum of ten extra pages regardless of the number of science instruments and unique flight elements. Every page upon which printing appears will count against the page limits and, unless specifically exempted (*e.g.*, Requirement B-30 and Requirement B-53 of the SALMON-2 AO), each foldout page will count as two pages against the page limits as appropriate for its area (*e.g.*, a fold-out with the total area of two standard pages counts as two pages, *etc.*).

The following Requirement supersedes Requirement B-15 of the SALMON-2 AO. It clarifies the information requested on the traceability of the proposed investigation, *e.g.*, instrument performance requirements. A modified template is available on the Explorers Heliophysics 2016 Library to assist proposers on presentation of the investigation traceability.

Requirement Q-42. Traceability from science goals to measurement requirements to instrument functional and performance requirements and to top-level mission requirements shall be provided in tabular form and supported by narrative discussion. Instrument projected performance shall be compared to the instrument performance requirements.

The following Requirement supersedes Requirement B-23 of the SALMON-2 AO and clarifies the information requested on instrument resource margins.

Requirement Q-43. Instrument Contingencies and Margins: This section shall summarize contingencies and margins of all instrument resources. It shall provide estimates of implementation design margins with respect to the required performance or allocations for mass, power, data storage, telemetry, and any other resource requirements. Discuss the allocation of contingency and margin to the instrument and/or suite (see SALMON-2 AO for definitions of contingency and margin).

The following Requirement supersedes Requirement B-24 of the SALMON-2 AO and clarifies the information requested on instrument performance margins.

Requirement Q-44. Performance Margins: For each instrument performance, this section shall provide estimates of performance margin with respect to the performance requirements as compared to projected performance estimates and shall justify that these performance margins are appropriate.

The following Requirement supersedes requirement B-27 of the SALMON-2 AO and clarifies the information requested on new technologies and/or advanced engineering development.

Requirement Q-45. This section shall describe any proposed new technologies and/or advanced engineering developments and the approaches that will be taken to reduce associated risks. Descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed system (level 3 WBS payload developments and level 3 WBS spacecraft elements) incorporating new technology and/or advanced engineering development at the time the proposal is submitted (for *TRL definitions*, see NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*, Appendix E, in the Program Library);
- Rationale for combining the TRL values of components and subsystems to derive each full system TRL as proposed, appropriately considering TRL states of integration (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*);
- Rationale for the stated TRL value of an element that is an adaptation of an existing element of known TRL;
- The approach for maturing each of the proposed systems to a minimum of TRL 6 by PDR:
 - Demonstration (testing) in a relevant environment can be accomplished at the system level or at lower level(s);
 - If applicable, justify what demonstration(s) in a relevant environment at lower level(s) (subsystem and/or subsystem-to-subsystem) would be sufficient to meet system level TRL 6, considering (i) where any new technology is to be inserted, (ii) the magnitude of engineering development to integrate elements, (iii) any inherent interdependencies between elements (e.g., critical alignments), and/or (iv) the complexity of interfaces – see the Program Library for examples;
 - Include discussion of simulations, prototyping, demonstration in a relevant environment, life testing, etc., as appropriate;
 - An estimate of the resources (manpower, cost, and schedule) required to complete the technology and/or advanced engineering development; and
 - Approaches to fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance liens they impose on the baseline design, and the decision milestones for their implementation.

If no new technologies or advanced engineering development is required, system TRL 6 or above at the time of proposal submission shall be clearly demonstrated.

Requirement Q-46 clarifies the intent of Requirement 89 and B-57 of the SALMON-2 AO. Requirement Q-46 supersedes requirement B-57 of the SALMON-2 AO.

Requirement Q-46. The following additional information is required to be supplied with the proposal as Appendices and, as such, will not be counted within the specified page limit. The proposer shall not include in these Appendices material required in the page-limited sections in the body of the proposal. Any additional information not specifically required in a given appendix will not be considered by the evaluation panel and may result in reduced ratings during the evaluation process or, in some cases, could lead to rejection of the proposal without review. No other appendices are permitted.

Requirement Q-47 further clarifies proposal heritage claims presented in Requirement B-70 of the SALMON-2 AO

Requirement Q-47. If a proposal claims any heritage from which the proposed investigation derives substantial benefit, this appendix shall discuss each element to an appropriate level of granularity (*e.g.*, component, assembly, subsystem) to clearly separate the heritage element from other elements of the design.

5.2. Proposal Submission Requirements

Requirement Q-48. Proposals must be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System, at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only.

Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement Q-49. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

5.3. Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this PEA, or in the documents available through the Explorers Heliophysics Program Library, should be sent to the E-mail address for questions listed in Section 7 of this PEA. Responses that are helpful and informative to proposers will be posted on the website listed in Section 7 of this PEA.

The deadline for receipt of questions is two weeks before the proposal due date listed in Section 7 of this PEA.

6. PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1. Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

In addition to the evaluation criteria given in Section 7.2.3 of the SALMON-2 AO, the evaluation of the *Experiment Science Implementation Merit and Feasibility of the Investigation* also includes the following additions to Factors B-2 and B-3:

- Factor B-2, probability of technical success, also includes the maturity and technical readiness of the instruments or demonstration of a clear path to achieve necessary maturity.
- Factor B-3, Merit of the data analysis, data availability, and data archiving plan. This factor includes the merit of plans for data analysis and data archiving to meet the goals and objectives of the investigation.

In addition to the evaluation criteria given in Section 7.2.4 of the SALMON-2 AO, the evaluation of the *TMC Feasibility of the Investigation Implementation, including Cost Risk* also includes the following additions to Factors C-1 and C-3:

- Factor C-1, an assessment of plans for the development and use of new instrument technology, plans for advanced engineering developments, and the adequacy of backup plans to mature systems within the proposed cost and schedule when systems having a TRL less than 6 are proposed.
- Factor C-3, plans for the development and use of new technology, plans for advanced engineering developments, and the adequacy of backup plans to ensure success of the mission when systems having a TRL less than 6 are proposed.

6.2. Selection Process

After the review by the SMD AO Steering Committee, the evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the final selection(s). As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency, including the Director of the Heliophysics Division, concerning the selections.

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among top-rated proposals, including, but not limited to, planning and policy considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the mission directorate(s).

6.3. Implementation Activities

Proposal selection and award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO with the following amendments.

6.3.1. Principal Investigator-led Team Masters Forum

One step toward successful execution of PI-led missions is to ensure that PI-led mission management teams receive the instruction necessary to enable them to better execute their missions for NASA. SMD, in conjunction with the NASA Academy of Program, Project, and Systems Engineering Leadership (APPEL), has established a 2.5 day PI-led Team Masters Forum for newly selected PI-led mission management teams. The purpose of the PI-led Team Masters Forum is to facilitate knowledge sharing in areas that are deemed necessary to successfully execute PI-led SMD science missions. Course attendance by the leaders of newly selected PI-led mission management teams (PI, Project Manager, Project Scientist, and Project Systems Engineer) and the NASA Headquarters Program Scientist and Program Executive (where assigned) is required as soon as practical after proposal selection.

6.3.2. Award Administration and Funding of Investigations

Oversight management responsibilities have been assigned to the Explorers Program Office at the Goddard Space Flight Center. The responsibilities of the Program Office will include oversight of investigation implementation; coordination of Government-furnished services, equipment and facilities; and contract management for selected investigations.

It is anticipated that the Program Office will provide funding to each selected investigation, as stated in Section 4.5.2; this award to perform a Phase A concept study is to be initiated as soon as possible after notification of selection. NASA Centers will receive funding via intra-agency funding mechanisms. In order to place Phase A awards in place, Statements of Work (SOWs) certified cost and pricing data, and small business subcontracting plans will be required for the Phase A concept studies.

Proposals are not required to include SOWs, cost and pricing data for Phase A concept studies and subsequent phases, or small business subcontracting plans. These will be required only for investigations that are selected at the outcome of the Step-1 competition. If more than one contractual arrangement between NASA and the proposing team is required, a separate SOW will be required for each organization.

For those investigations that are selected, it will be in the best interest of their PI-led mission management teams to provide SOWs, cost and pricing data, and small business subcontracting plans in as timely a manner as possible. The process of awarding contracts cannot begin until SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed.

SOWs will be required for selected investigations regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the requirement for a Phase A Concept Study Report as described in the *Guidelines and Criteria for the Phase A Concept Study* document available in the Program Library, as well as general task statements for Phases B through F. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). SOWs need not be more than a few pages in length.

Each Phase A contract will contain a priced option for a Bridge Phase, to be exercised upon investigations down-selected to proceed into Phase B. The Bridge Phase option will allow work to be continued uninterrupted under the contract after a Step-2 downselection decision is made. The Bridge Phase is intended to cover a four-month period of Phase B effort to provide program continuity while negotiations are completed to modify the contract to include Phases B, C/D, and E/F. The Bridge Phase Option will be exercised only on the contract for the investigation that is chosen during the Step-2 downselection process to continue beyond the Phase A concept study. The Bridge Phase option will allow the Government to continue work under the contract after a Step-2 downselection decision is made. Additional phases will be added to the contract after each Phase has been approved through the program review process. The four-month Bridge Phase period will be used to begin the negotiation of the remaining phases of the contract with the successful PI downselected during following Step 2.

6.3.3. Conduct of the Phase A Concept Study

The concept studies are intended to provide NASA with more definitive information regarding the cost, risk, and feasibility of the investigations, as well as a detailed plan for the conduct of any optional student collaboration, before final selection for implementation. The product of the concept studies is a Phase A Concept Study Report to be delivered by each selected investigation team 11 months following the establishment of initial contracts. The content and format of the study reports are specified in the *Guidelines and Criteria for the Phase A Concept Study* document in the Program Library.

The PI will provide in the Phase A Concept Study Report a proposed set of Level 1 requirements, including the criteria for full investigation success satisfying the Baseline Science Investigation and the criteria for minimum investigation success satisfying the Threshold Science Investigation. The PI will also provide in the Phase A Concept Study Report the allocation of the proposed cost reserves among the appropriate WBS elements. The PI-Managed Mission Cost will not increase by more than 20% from that in the Step-1 proposal to that in the Phase A Concept Study Report, and, in any case, will not exceed the Cost Cap. The NASA review of the completed Concept Study Report will include all investigation facets. Risk reduction that has been accomplished during Phase A will be closely reviewed. NASA may request presentations and/or site visits to review the final concept study results with the investigators.

Each investigation's Concept Study Report must conclude with a commitment by the PI for the cost, schedule, and scientific performance of the investigation. For each Phase B selection, and unless otherwise stated in the selection letter, the selected investigation's cost will be set at the Concept Study Report's proposed cost.

NASA cannot guarantee that the proposed funding profile can be accommodated within the Heliophysics Explorers Program's budget. A funding profile for the selected investigation will be negotiated during Phase B.

6.3.4. Downselection of Investigations

The SMD Associate Administrator will make downselection decisions based on the evaluation of the Phase A Concept Study Reports and on programmatic considerations. The criteria for evaluating the concept study are as follows:

1. Scientific merit of the proposed investigation;
2. Science implementation merit and feasibility of the investigation;
3. Technical, management, and cost feasibility of the investigation implementation, including cost risk; and
4. Quality of plans for small business subcontracting plans and optional student collaboration, if proposed.

The evaluation criteria and downselection factors are described in the *Guidelines and Criteria for the Phase A Concept Study* document that will be available in the Program Library. Any substantial changes to science contained in the Phase A Concept Study Report will result in its re-evaluation: if no substantial changes are found to have been made to science, the Step-1

evaluation of the first criterion will be maintained.

Proposers may be asked for specific information at the time of selection for a competitive Phase A. This requested information will need to be included in the Phase A Concept Study Report and will be considered at the time of downselection for flight.

At the conclusion of Phase A, it is anticipated that the Selecting Official will continue one or two investigations into the subsequent phases of mission development for flight and operation. The target date for this continuation decision (i.e. "Down-Selection") is given in Section 7

An investigation may be downselected to enter Phase B or may be downselected for a funded Extended Phase A so they can retire one or more risks before they are allowed to proceed to Phase B. There is no guarantee that an investigation downselected for an Extended Phase A will be approved to enter Phase B, even if all risks have been retired during the Extended Phase A. In no case is NASA required to exercise any option. NASA will not exercise any contract option nor continue funding those investigations not selected to proceed.

Upon a continuation decision, NASA will execute the Bridge Phase option and begin to provide additional funding for the project that is continued beyond the Phase A concept study. During the Bridge Phase, NASA and the continued project will negotiate and sign a contract modification necessary for the remaining portion of mission phases. Deliverables will be negotiated during the Bridge Phase, on the basis of information provided in the Concept Study Report.

In no case is NASA required to exercise any option. NASA will not exercise any contract option nor continue funding those investigations not selected to proceed. For those investigations that are not continued, the contracts will be allowed to terminate without further expense to NASA. Every investigation team will be offered a debriefing of the evaluations of its Concept Study Report.

6.3.5. International Agreements

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, the Science Division of NASA's Office of International and Interagency Relations will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail an exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency MOU. For additional policies and requirements, see Section 5.9 of the SALMON-2 AO.

7. SUMMARY OF KEY INFORMATION

Funding available	See Section 4.5.1 of this PEA
Community Announcement	September 9, 2015
Release of Draft PEA Date	March 11, 2016
Comments Due on Draft PEA	April 8, 2016
Final PEA Release Date	July 13, 2016
[Amended July 20, 2016]	
Date for Preproposal Conference	August 15, 2016 via Webex
<u>Due Date for NOI (notice of intent to propose)</u>	11:59 pm eastern time on August 19, 2016
Date for Preproposal Conference	August 9, 2016 via Webex
<u>Due Date for NOI (notice of intent to propose)</u>	11:59 pm eastern time on August 16, 2016
Due Date for Proposals	11:59 pm eastern time on October 14, 2016
Selection Date for Competitive Phase A Studies	Spring 2017
Concept Study Reports Due	Spring 2018
Down-Selection Date	Fall 2018
Web site for additional information for the Heliophysics Explorer MO PEA	http://explorers.larc.nasa.gov/HPSMEX/MO/index.html
Program Library for the Astrophysics Explorer PEA	http://explorers.larc.nasa.gov/HPSMEX/MO/program_library.html
Submission Medium	Electronic copies only; see Section 5.2 of this PEA
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)
NASA point of contact	Dr. J. Daniel Moses Heliophysics Explorers Program Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-0558 E-mail: dan.moses@nasa.gov

END OF PEA Q

NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)
NNH12ZDA0060-APEXMO3
PROGRAM ELEMENT APPENDIX (PEA) R
ASTROPHYSICS EXPLORERS MISSION OF OPPORTUNITY

On or about October 21, 2016, NASA amended this Announcement of Opportunity as follows:

The deadline for the submission of a Notice of Intent (NOI) to propose has been changed to October 27, 2016.

Note the Deadline for Proposal Submission has not changed from December 15, 2016.

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SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)
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PROGRAM ELEMENT APPENDIX (PEA) R
ASTROPHYSICS EXPLORERS MISSION OF OPPORTUNITY

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SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)

NNH12ZDA0060-APEXMO3
PROGRAM ELEMENT APPENDIX (PEA) R:
ASTROPHYSICS EXPLORERS MISSION OF OPPORTUNITY

1 BACKGROUND

1.1 Programmatic Overview

The National Aeronautics and Space Administration (NASA) issues this Second Stand Alone Missions of Opportunity Notice (SALMON-2) Program Element Appendix (PEA) for the purpose of soliciting proposals for Astrophysics Mission of Opportunity (MO) science investigations to be implemented through its Explorers Program.

Three Mission of Opportunity types may be proposed in response to this PEA: (1) Partner Missions of Opportunity (PMOs), (2) New Missions using Existing Spacecraft (NMESs), and (3) Small Complete Missions (SCMs). SCMs include investigations on the International Space Station (ISS), suborbital-class missions (an investigation requiring flight on a high-altitude scientific balloon platform or on a suborbital Reusable Launch Vehicle (sRLV), or as a CubeSat investigation – see Section 4.5.1 and Requirement R-10), investigations launched as secondary payloads, or investigations launched as hosted payloads. A fourth type of investigation, U.S. Participating Investigators (USPIs), may be proposed in response to Appendix D.13, Astrophysics Explorers U.S. Participating Investigators, of the NASA Research Announcement, Research Opportunities in Space and Earth Sciences 2016 (ROSES-2016), which is being released simultaneously with this PEA.

Investigations may target any astrophysics scientific investigation that advances the objectives outlined in Section 2.1 of this PEA. Investigations that address NASA goals in other areas, such as heliophysics, Earth science, or planetary science, are not solicited.

1.2 Explorers Program Background

The Explorers Program is the oldest continuous program in NASA. It is comprised of a longstanding series of space science missions that are independent, but share a common funding and NASA oversight/insight management structure. Initiated with the Explorer 1 launch in 1958 and including the Nobel Prize recognized Cosmic Background Explorer (COBE) mission, the Explorers Program has launched over 90 missions.

Though historically not always this way, the program currently administers only Principal Investigator (PI)-led science investigations for the Heliophysics and Astrophysics Divisions of NASA's Science Mission Directorate (SMD). Competitive selection by peer review ensures that the best and most current science affordable within the Cost Cap will be accomplished.

Since the early 1990s, the Explorers Program has provided several types of flight opportunities for addressing astrophysics and heliophysics science objectives. These mission types are defined

by their Cost Caps and are designed to increase the number of flight opportunities in response to recommendations from the scientific community. The Explorers Program currently consists of two types: larger stand-alone “full missions,” for which NASA offers a dedicated launch vehicle, and smaller investigations called “missions of opportunity.”

An Explorers MO is an investigation generally characterized by being part of a host space mission other than a strategic SMD mission, or by being a small complete mission with its own identified access to space, or by being a new science investigation utilizing an existing operating spacecraft that has completed its prime mission. For each Explorers AO, full mission or MO, the budget available varies, as do the types of investigations that may be proposed.

Explorers MOs are solicited through the SALMON-2 AO (NNH12ZDA006O) by amending it with a specific Program Element Appendix. This solicitation for Astrophysics Explorers Mission of Opportunity is one such PEA.

1.3 Overview of this Program Element Appendix

The SALMON-2 AO is an omnibus solicitation that provides the overall structure, guidelines and requirements for several types of MO solicitations. Each new opportunity is announced through a PEA that details the solicitation and may include additional guidelines and requirements. This document is one such PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/> or at <http://go.nasa.gov/SALMON2-AO>.

NASA issues this PEA as an appendix of the SALMON-2 AO for the purpose of soliciting proposals for Astrophysics Explorers MO investigations to be managed under the NASA Explorers Program. All investigations proposed in response to this solicitation must support NASA’s astrophysics science goals (Section 2.1 of this PEA) and the goals and objectives of the Explorers Program (Section 2.2 of this PEA), must be implemented by Principal Investigator (PI)-led investigation teams (Sections 4.2.4 and 5.4.1 of the SALMON-2 AO), and must result in the provision of complete space investigations (Section 5.3.2 of the SALMON-2 AO).

Proposals submitted in response to this PEA will be selected for flight nominally through a two-step competitive process. Proposals submitted in response to this PEA will undergo the first step evaluation. As the outcome of the first step evaluation, NASA intends to fund one or more MO investigations to proceed to a nine month Phase A concept study. In the second step, NASA will conduct an evaluation of the Phase A concept study reports. From this evaluation, NASA expects to select one or more MOs to proceed into Phase B and subsequent mission phases.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO contains additional requirements on the format and content of the proposals. Documents available through the Astrophysics Explorers Mission of Opportunity Program Library at <http://explorers.larc.nasa.gov/APMIDEX2016/MO/programlibrary.html> (hereafter referred to as the Program Library) are intended to provide guidance for investigations selected; they are specifically not intended to impose requirements on proposals.

1.4 NASA Online Document Information System

NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents are available through the NASA On-line Document Information System (NODIS) at <http://nodis3.gsfc.nasa.gov/>. Once the final PEA is released, copies of appropriate versions of NPD and NPR documents referenced in the PEA will be placed in the Program Library. Those copies should be used to prepare proposals since documents in NODIS are subject to change.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 NASA Astrophysics Science Objective and Goals

One of NASA's strategic goals is to expand the frontiers of knowledge, capability, and opportunity in space. Further information on NASA's strategic goals may be found in NASA Policy Directive (NPD) 1001.0B, the *NASA 2014 Strategic Plan*, available through the Program Library or at <http://science.nasa.gov/about-us/science-strategy/>.

NASA SMD addresses this NASA strategic goal through four broad strategic objectives. One of these strategic objectives is to “discover how the universe works, explore how it began and evolved, and search for life on planets around other stars.” SMD addresses this objective by conducting astrophysics investigations designed to address the following science goals:

- Probe the origin and destiny of our universe, including the nature of black holes, dark energy, dark matter, and gravity;
- Explore the origin and evolution of the galaxies, stars, and planets that make up our universe;
- Discover and study planets around other stars and explore whether they could harbor life.

Further information on the goals and objectives of NASA's astrophysics programs may be found in the *NASA 2014 Science Plan*, available at <http://science.nasa.gov/about-us/science-strategy/> or through the Program Library, and in the Astrophysics roadmap, *Enduring Quests Daring Visions, NASA Astrophysics in the Next Three Decades*, available through the Program Library.

2.2 Explorers Program Goals and Objectives

The goal of NASA's Explorers Program is to provide frequent flight opportunities for high quality, high value, focused astrophysics science investigations that can be accomplished under a not-to-exceed Cost Cap and that can be developed relatively quickly, generally in 36 months or less, and executed on-orbit in less than three years.

The Explorers Program accomplishes these world-class space science investigations utilizing efficient management approaches to contain mission cost through commitment to, and control of, design, development, and operations costs.

The Explorers Program provides an effective means of timely achievement of strategic goals. By conducting a rapid series of science investigations, NASA is responsive to new knowledge, technology, and science priorities. Pressing questions in astrophysics science are addressed, permitting a steady improvement in our understanding of astronomical systems and the processes that affect them. The frequent, steady nature of the investigations ensures a continuing stream of

fresh scientific data to the broader science community, thus maintaining the excellence of the U.S. space science program and the inspiration of a new generation of investigators.

The Explorers Program strives to:

- advance scientific knowledge of astrophysics and heliophysics processes and systems;
- add scientific data and other knowledge-based products to data archives for all scientists to access;
- lead to scientific progress and the publishing of results in the peer-reviewed literature to encourage, to the maximum extent possible, the fullest commercial use of the knowledge gained;
- implement technology advancements prepared in related programs; and
- announce scientific progress and results in popular media, scholastic curricula, and materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

2.3 NASA Management of the Explorers Program

The selected investigation(s) will be managed by the Explorers Program. The Associate Administrator for SMD has established the Explorers Program Office at the NASA Goddard Space Flight Center (GSFC) to be responsible for project oversight. The Explorers Program Manager at NASA GSFC reports to the Astrophysics Explorers Program Director at NASA Headquarters. Additional details about the program office staffing, structure, and goals can be found in the *Explorers Program Plan*, available through the Program Library. There are appropriate protective firewalls between the Explorers Program Office and the rest of NASA GSFC, allowing investigators from GSFC to propose in response to this PEA. The Explorers Program Office will manage the Astrophysics Explorers Mission of Opportunity investigations under the requirements of NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, as described in Section 4.1.2 of the SALMON-2 AO. Safety, reliability, and mission assurance requirements for Astrophysics Explorers Mission of Opportunity investigations will be consistent with the *Standard Mission Assurance Requirements* document found in the Program Library.

All references to NPR 7120.5D NID in SALMON-2 should be interpreted as referencing NPR 7120.5E.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

This solicitation is an appendix to the NASA SALMON-2 AO. The SALMON-2 AO provides the overall structure and guidelines for several types of mission of opportunity solicitations. Each new opportunity is announced with a Program Element Appendix (PEA). This document is such a PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com> and at <http://go.nasa.gov/SALMON2-AO>

The following schedule applies to this PEA.

- A Preproposal teleconference/WebEx will take place in association with this solicitation. Further information will be available at the Astrophysics Explorers Mission of Opportunity

Acquisition website (<http://explorers.larc.nasa.gov/APMIDEX2016/MO/index.html>) prior to the Preproposal teleconference/WebEx. The purpose of this Conference will be to address questions about the proposal process for this PEA. Questions should be sent to the Astrophysics Explorers Program Scientist at the address given in Section 6.1.5. NASA personnel will address all questions that have been received no later than five working days prior to the Conference. Questions submitted after this date may be addressed at the Conference as time permits and as appropriate answers can be generated. Anonymity of the authors of all questions will be preserved.

- Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA. The period for questions will close two weeks before the proposal due date. Answers will be provided no later than ten days before the proposal due date.
- A Notice of Intent (NOI) to propose to this announcement is required. NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Section 6.1.2 of the SALMON-2 AO provides information on electronic NOI submission through NSPIRES. Submitting an NOI does not commit the team to submitting a proposal.
- All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.
- Evaluation and selection for flight will be done using a two-step selection process.
- NASA funded Phase A activities will be conducted by the investigation team(s) selected as a result of the first step of this solicitation.
- NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four weeks following receipt of the Statement of Work, as set forth in Section 6.3.2 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Participate in this Proposal Opportunity

Refer to Section 4.2 of the SALMON-2 AO for the policies on participation policy. For this particular PEA, NASA will place full or partial limitations (as described in the SALMON-2 AO) on organizations that will be involved in the evaluation process. Cornell Technical Services LLC is subject to the “Full Limitation” as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on the Aerospace Corporation.

4.1.1 NASA Center Role in Communications and Outreach

Each flight mission must utilize the communications office of a NASA center or JPL to manage the communications plan and activities. Missions managed by a NASA center or JPL will assign the management role to that center’s communications office. For missions not managed by a NASA center or JPL, Goddard Space Flight Center, the center where the Explorers Program Office resides, will fill the communications management role.

These communications offices will be responsible for leading, coordinating, and executing mission communications activities – in coordination with the PI – and with approval of Headquarters SMD and Office of Communications.

NASA's Principal Investigators (PIs) fill a challenging, multidisciplinary role, which demands excellent communication, team building, and management skills. The PI is a key spokesperson for the mission – along with NASA officials – and is integral in communicating mission updates, science, and new discoveries.

The PI provides content, analysis, and context for communication campaigns and news stories. In keeping with NASA's communications goals, this content should convey an understanding of the mission, its objectives, and benefits to target audiences, the public, and other stakeholders.

The PI will coordinate with the designated NASA center communications office for all mission-related communications activities. The PI, or his or her designee, shall review all news releases issued for the mission. In case of incompatible views, NASA will have final decision on release of public products, while ensuring that scientific and technical information remains accurate and unfiltered.

Selected PIs also must work with NASA to ensure their mission website follows NASA requirements for providing content on the agency's primary public website at <http://www.nasa.gov/>. NASA, and through NASA the selected investigation, is required under the Information Quality Act (44 U.S.C. 3504(d)(1) and 3516) and associated guidelines to maximize the quality, objectivity, utility, and integrity of information and services provided to the public.

A Communications and Outreach (previously referred as Public Outreach) program is required. Mission-related communications are funded directly through the NASA Center and are not within the PI-Managed Mission Cost. The communications plan must be developed during Phase B of the mission. The plan must include topline messaging, target audiences, and media processes linked to reaching target audiences and associated detailed budgets, milestones, metrics and timelines, and reporting requirements.

4.2 Types of Mission of Opportunity

Three Mission of Opportunity types may be proposed in response to this solicitation: (1) Partner Missions of Opportunity (PMOs), (2) New Missions using Existing Spacecraft (NMESs), and (3) Small Complete Missions (SCMs). SCMs include investigations on the International Space Station (ISS), suborbital-class missions (an investigation requiring flight on a high-altitude scientific balloon platform or on a suborbital Reusable Launch Vehicle (sRLV), or as a CubeSat investigation), investigations launched as secondary payloads, or investigations launched as hosted payloads. See Section 5.1 of the SALMON-2 AO for complete descriptions of these types of MOs, as well as constraints and requirements for proposals.

A fourth type of investigation, U.S. Participating Investigators (USPIs), may be proposed in response to ROSES-2016 Appendix D.13. A USPI proposes to participate as a Co-I for an instrument, experiment, or technology demonstration that is being built and flown by a sponsor agency other than NASA. NASA will release simultaneously with this PEA a solicitation for Astrophysics Explorers U.S. Participating Investigators through the ROSES-2016 NASA

Research Announcement (NRA) (NNH16ZDA001N). The Astrophysics Explorers USPI program element appendix of the ROSES-2016 NRA is available at <http://nspires.nasaprs.com/> or at <http://solicitation.nasaprs.com/ROSES2016>. USPI proposals submitted to that solicitation will be due at the same time as the Astrophysics Explorers MOs. USPI NOIs and proposals will be submitted in response to the ROSES-2016 amendment, will be subject to the proposal guidelines specified in ROSES-2016, will be subject to the constraints (cost, schedule, technical) and requirements specified in ROSES-2016, and will be reviewed and selected using the proposal criteria specified in ROSES-2016.

4.3 Science Requirements and Constraints

The science goals are described in Section 2 of this PEA. Any appropriate science question relevant to NASA's astrophysics science goals may be addressed with the proposed investigations. Section 2 of this PEA provides the basis for the evaluation of intrinsic science merit, as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside astrophysics science goals, as described in Section 2 of this PEA, are not solicited.

Requirement R-1. Proposals shall address appropriate science questions relevant to the NASA astrophysics science goals described in Section 2 of this PEA.

Requirements for documentation in the proposal of the flow-down of requirements from the proposed science goals are described in Section 5.2.2 of the SALMON-2 AO.

Requirement R-2. Each proposal shall clearly define its science question or questions, shall demonstrate how the science questions map into high-level science requirements, and shall show how the science requirements subsequently map into measurement, data, instrument, and mission requirements.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement R-3. Each proposal shall clearly state the baseline and threshold requirements for the mission and the baseline and threshold mission lifetime.

Investigation Co-Investigators and collaborators are defined in Section 5.6 of the SALMON-2 AO.

Requirement R-4. Each proposal shall explicitly define the role of the PI, each Co-Investigator (Co-I), and each collaborator, the necessity of that role for the proposed investigation shall be justified, and the funding source (NASA or contributed) shall be noted.

NASA expects each proposal to fully describe the requirements for calibration and validation of the instruments and the data returned. Other data policies and requirements are given in Section 4.4 of the SALMON-2 AO and Section 4.6.6 of this PEA.

Requirement R-5. Each proposal shall fully describe the requirements for calibration and validation of the instruments and the data returned.

4.4 Telecommunications, Tracking, and Navigation

This section provides additional information for section 5.3.6 of the SALMON-2 AO.

It is SMD policy that only one DSN 34 meter antenna will be scheduled at the same time during normal operations of the selected Astrophysics Explorers mission. It is SMD policy that none of the DSN 70 meter antennas may be proposed to support normal operations of the selected Astrophysics Explorers mission. These restrictions do not apply to station hand-offs, critical event coverage, emergency services, radio science measurements, or navigation observations (e.g., delta differential one-way ranging or delta-DOR).

NASA intends to transition all space missions to the use of Ka-band for science data return (telemetry, tracking, and commanding (TT&C) data may still be transmitted using X-band or S-band). In order to better manage the Agency's transition to Ka-band service, proposed investigations are required to baseline the use of Ka-band for science data return, unless it is inappropriate.

Radio frequency spectrum for telecommunications is allocated by service (e.g., Earth Exploration-Satellite, Space Research, and Space Research (Deep Space)) and may be further constrained by maximum channel bandwidth limits (see the *Available Spectrum and Channel Limits By Allocated Service* document in the Program Library). Proposals are required to address conformance to applicable maximum channel bandwidth limit(s).

Requirement R-6. Proposals shall baseline the use of Ka-band for science data return, unless it is inappropriate for the proposed investigation; proposal of an alternative communications approach shall be justified.

Requirement R-7. Proposals shall address conformance to applicable maximum channel bandwidth limit(s).

Requirement R-8. Proposals that propose the use of the DSN shall baseline the use of only one DSN 34 meter at any time for normal operations (not including periods of station hand-off).

4.5 Cost and Schedule Requirements and Constraints

4.5.1 Cost Requirements and Constraints

The PI-Managed Mission Cost is defined in Section 4.3.1 of the SALMON-2 AO. Except for suborbital-class missions (a high-altitude scientific balloon mission, a mission on an sRLV, or a CubeSat mission), the PI-Managed Mission Cost Cap for an Astrophysics Explorers Mission of Opportunity, including all mission phases and the cost of accommodation on and/or delivery to the host mission, if applicable, is \$70 million in NASA Fiscal Year (FY) 2017 dollars. The PI-Managed Mission Cost Cap is \$35 million in FY 2017 dollars for suborbital-class missions.

NASA expects to select one or more Astrophysics Explorers Missions of Opportunity. If multiple selectable missions are proposed with combined costs within the available funding, anticipated to be approximately \$70 million, NASA may select more than one proposed investigation.

Requirement R-9. Proposals shall be for complete investigations including Phases A-F.

Requirement R-10. The proposed PI-Managed Mission Cost for the Astrophysics Explorers Missions of Opportunity shall be no more than \$70 million in FY 2017 dollars, except for suborbital-class missions (defined as (a) a high-altitude scientific balloon mission, (b) a mission on an sRLV, or (c) a CubeSat mission), for which it shall be no more than \$35 million in FY 2017 dollars.

Requirement R-11. Proposals shall include detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Mission Cost).

4.5.2 Schedule Requirements and Constraints

For a PMO, the proposing PI must provide evidence that the sponsoring organization intends to fund the primary host mission, including currently-not-yet-selected missions from an identified mission opportunity of another agency, and that the NASA commitment for U.S. participation is required by the sponsoring organization prior to January 2022. The launch date itself for a PMO is not constrained. For a NMES, the proposing PI must provide evidence that a decision by NASA on whether or not to conduct the proposed new mission extension is required prior to January 2022.

For Small Complete Mission (SCM) MOs, proposers must specify the launch readiness date in the proposal, which is to be no later than December 31, 2022. Astrophysics Explorers SCM MO investigations with an anticipated launch readiness date requirement later than December 31, 2022, should be proposed in response to a subsequent opportunity.

For balloon missions planned for launch from Antarctica during the December 2022 - January 2023 campaign, "launch readiness" per this requirement is considered to be the same as being at the Columbia Scientific Balloon Facility (CSBF) and ready to complete predeployment integration and testing with the CSBF support systems. June is the normal month to begin predeployment integration and testing at the CSBF for Antarctic balloon missions, which in the case of this MO, must be completed no later than August 20, 2022.

Proposers should be aware that it may be necessary for NASA to adjust the launch date and definition phasing of selected investigations from that proposed in order to conform to the available Astrophysics Explorers Program budget profile and/or NASA's ability to negotiate a launch opportunity to the International Space Station, for a high-altitude scientific balloon mission, for launch opportunities on reusable launch vehicles, or for CubeSat launches; therefore, the degree of launch date flexibility must be indicated in the proposal.

It is intended that proposed investigations be evaluated and selected through a two-step competitive process. Step 1 is the solicitation, submission, evaluation, and selection of proposals prepared in response to this PEA. The Step 1 evaluation and selection process is described in Section 7 of the SALMON-2 AO. As the outcome of Step 1, NASA intends to select one or more Step 1 proposals for Phase A study and evaluation, if their perceived value to the Astrophysics Explorers Program is significant. NASA will issue awards (provide funding to NASA Centers and the Jet Propulsion Laboratory (JPL), award contracts to non-NASA institutions, or utilize other funding mechanisms, as applicable) to the selected proposers to conduct Phase A concept studies and submit Concept Study Reports to NASA. Step 2 is the preparation, submission, evaluation, and continuation decision (downselection) of the Concept Study Reports. As the outcome of Step 2, NASA may continue one or more investigations into the subsequent phases of mission development for flight and operations.

Proposers selected through this AO will be awarded a contract to conduct a Phase A concept study with duration of approximately nine months and capped at \$500,000 FY 2017 dollars.

A proposal may be selected for development without first completing a Phase A concept study. The proposal must make the case that it is not only necessary, but also that it is also technically feasible for the project to be selected for development without a competitive Phase A concept study. The proposer must recognize that NASA would only make such a decision without a Phase A competition if the MO proposal were especially compelling.

Requirement R-12. Proposals shall include a detailed development schedule (including integration plans) and an associated budget that for a SCM secures the launch before December 31, 2022, or for a PMO or a NMES is consistent with the documented launch and operations schedule of the primary host mission.

4.5.3 Access to Space Cost Requirements

The following classes of platforms are provided by NASA for access to space, or near space, at no cost to the PI-Managed Mission Cost (see Section 4.6.2 and Section 4.6.3 of this PEA for additional information).

- Access to space will be provided by NASA for a mission on the International Space Station (ISS).
- NASA will provide the balloon vehicle and balloon launch services for a mission on a high-altitude scientific balloon.
- The platform is provided by NASA to host a payload on an sRLV.
- NASA will provide launch and deployment services for a CubeSat mission.

For SCMs larger than a CubeSat that require launch and deployment from an Expendable Launch Vehicle (ELV), the proposal must specify whether the access to space is to be provided by NASA, for which a charge against the PI-Managed Mission Cost must be included, or secured by the PI. The charge for NASA-provided access to space varies by size and whether a dedicated launch is required; see the *Launch Services Program Small Payload Access to Space Catalog* in the Program Library. If the PI secures access to space, including as a hosted payload, any costs for access to space must be included in the PI-Managed Mission Cost.

Requirement R-13. With the exception of small complete missions to the International Space Station or suborbital-class missions, any costs for access to space must be included in the PI-Managed Mission Cost.

4.5.4 Full Cost Accounting for NASA Facilities and Personnel

This Section supersedes Section 5.5.5 of the SALMON-2 AO.

For the purpose of calculating the full cost of NASA-provided services, proposal budgets from NASA Centers, whether as the proposing organization or as a supporting organization, are to include within the PI-Managed Mission Cost all costs normally funded by an SMD Project under NASA's full cost accounting practices, including civil servant labor (salaries and benefits), civil service travel, and procurements. All of these costs must be clearly identified by year within the budget justification section of the proposal.

Estimated NASA Center Management and Operations (CM&O) overhead costs must also be included within the Cost Cap, to enable a level playing field for all proposers. Per HQ policy guidance signed in June 2010 by the Associate Administrator, Mission Support Directorate and by the Agency Chief Financial Officer, all Centers shall use an identical CM&O burden rate of \$45K (FY 2017) per "equivalent head." For years after FY 2017, this number must be inflated. Per Agency policy, this rate must be applied as a "cost per equivalent head" to all Civil Service full time equivalents (FTEs) plus on/near site contractor work year equivalents (WYEs) associated with the proposal. The estimated FTEs and WYEs per fiscal year, and the resulting CM&O burden, must be identified in a separate table within the budget justification section of the proposal.

The CM&O burden costs must be clearly denoted in all budget tables. These costs may not be included or rolled into any other budget lines in such a way that they become unidentifiable.

Do not include within the cost proposal, or within the PI-Managed Mission Cost, any estimate for Agency Management and Operations (AM&O, a.k.a. NASA Headquarters overhead).

Table 1: Cost Elements for NASA Center Budget Proposals in response to SMD AOs

	Identify in proposal?	Include in PI-managed mission cost?	Funding source	Comments
Civil Service Labor	Yes	Yes	SMD Program	Includes salaries and benefits
Civil Service Travel	Yes	Yes	SMD Program	
Other Direct/Procurements	Yes	Yes	SMD Program	Includes procurements as typically identified by flight projects in the NASA N2 budget database
CM&O	Yes	Yes	CASP	Applied to NASA provided labor, including Center civil servants and on-site contractors

AM&O	No	No	CASP	Includes NASA provided independent technical authority
NASA Contributed Costs	Yes	No	Identify	Must be non-SMD
Non-NASA Federal Government (funding requested from NASA)	Yes	Yes	SMD Program	If NASA funding is requested for the non-NASA Federal Government agency
Contributions	Yes	No	Identify	Includes all non-NASA contributions

Requirement R-14. Proposals including costs for NASA Centers shall conform to the full cost policy stated in this Section. Each of the elements of the NASA Center costs (direct labor, travel, procurements) shall be separately identified by year.

If any NASA funded item(s) or services are to be considered as contributed costs, then the contributed item(s) must be separately funded by a non-SMD effort complementary to the proposed investigation, the value of the contribution(s) must be estimated, and the funding source(s) must be identified.

Requirement R-15. If any NASA funded item(s) or services are considered as contributed costs, then the proposal shall estimate the value of the contribution(s) and shall identify the funding source(s).

Any non-NASA Federal Government costs must follow the appropriate agency accounting standards for full cost. If no standards are in effect, the proposers must follow the *Managerial Cost Accounting Concepts and Standards for the Federal Government*, as recommended by the Federal Accounting Standards Advisory Board and available in the Program Library.

Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

4.6 Technical Requirements and Constraints

4.6.1 New Technologies/Advanced Engineering Development

This Section intends to clarify the requirement for New Technologies and/or Advanced Engineering Developments and supersedes Section 5.3.4 of the SALMON-2 AO.

This PEA solicits PMOs, NMESs, and SCMs for flight missions, not technology or advanced engineering development projects. Proposed investigations are generally expected to have mature technologies, with systems at a Technology Readiness Level (TRL) of 6 or higher. For the purpose of TRL assessment, systems are defined as level 3 Work Breakdown Structure (WBS) payload developments (i.e., individual instruments) and level 3 WBS spacecraft elements (e.g., electrical power system); see Figure 3-7 of the *NASA WBS Handbook*, NASA/SP-2010-3404, which can be found in the Program Library. TRLs are defined in NPR 7123.1B NASA

Systems Engineering Processes and Requirements, Appendix E, which can be found in the Program Library.

Proposals with a limited number of less mature technologies and/or advanced engineering developments are permitted, as long as they contain a plan for maturing systems to TRL 6 (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*, <http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20080008301.pdf>) by no later than Preliminary Design Review (PDR) and adequate backup plans that will provide mitigation in the event that the systems cannot be matured as planned. The TRL state of systems will be validated by an independent team at PDR.

Requirement R-16. Proposals that use systems currently at less than TRL 6 shall include a plan for system maturation to TRL 6 by no later than PDR and a backup plan in the event that the proposed systems cannot be matured as planned (see Section 5.1 of this PEA, for additional detail).

4.6.2 Additional Requirements for Partner Mission of Opportunity Investigations

The following requirements are in addition to those given in Section 5.1.1 of the SALMON-2 AO.

Requirement R-17. In addition to the requirements given in the SALMON-2 AO, all proposed PMO investigations must also demonstrate: (1) their formal relationship with the sponsoring agency's host mission (e.g., already selected contribution, invited contribution, or proposed contribution); and (2) the status of the host mission within the sponsoring agency (i.e., Pre-Phase A, Phase A, or Phase B), including the level of commitment that the sponsoring agency has made to complete the mission.

Requirement R-18. In addition to the requirements given in the SALMON-2 AO, all proposed PMO investigations requiring flight on the ISS must also provide a Letter of ISS Technical Interface and Resource Accommodation Feasibility Assessment from the NASA Space Station Research Integration Office. This ISS Letter of Feasibility Assessment must contain: (1) a description of the formal relationship with the sponsoring agency's host mission for access and accommodation at the space station, (2) identification of known challenges and/or conditional provisions for access or accommodation of the host mission, and (3) a description of the level of technical interchange and negotiation required to mature the host mission's provisions for access and accommodation.

Section 4.6.3.1 contains additional information related to investigations requiring flight on the ISS.

PMOs may be proposed for participation in nonstrategic NASA missions. A PMO may be proposed for participation in a PI-led NASA mission from a program other than Astrophysics Explorers (an Astrophysics Explorers MO may not be proposed for an Astrophysics Explorers mission).

Requirement R-19. A proposal for a PMO hosted by a PI-led mission from a program other than the Astrophysics Explorers Program must satisfy the following requirements: (1) The proposal must include a Letter of Commitment from the PI of the host mission endorsing the partnership and (2) the feasibility assessment of the host mission, i.e., the technical, management, and cost (TMC) evaluation in Step 1 and Step 2, must include the accommodations for the proposed PMO instrument.

4.6.3 Additional Requirements for Small Complete Mission of Opportunity Investigations

The following requirements are in addition to those in Section 5.1.3 of the SALMON-2 AO.

Requirement R-20. In addition to the requirements given in the SALMON-2 AO, all proposed SCM investigations, with the exception of investigations requiring flight on the ISS, suborbital-class missions, or NASA-provided launch vehicles (see Section 4.6.3.5), must also provide a Letter of Commitment from the program or agency providing access to space. This Letter of Commitment must contain: (1) a detailed description of the proposed provisions for access to space (e. g., launch to orbit provided by industrial or non-U.S. partner, secondary ride on another U.S. sponsored mission, etc.), and (2) the status of those proposed flight provisions within the sponsoring program or agency (i.e., conditional, confirmed, conceptual, etc.) including the level of commitment that the sponsoring program/agency has made to support that flight opportunity.

4.6.3.1 Investigations Hosted on the ISS

SCMs may be proposed for the ISS. Investigations requiring flight on the ISS must provide a Letter of ISS Technical Interface and Resource Accommodation Feasibility Assessment from the NASA Space Station Research Integration Office.

Requirement R-21. In addition to the requirements given in the SALMON-2 AO, all SCM investigations requiring flight on the ISS must also provide a Letter of ISS Technical Interface and Resource Accommodation Feasibility Assessment from the NASA Space Station Research Integration Office demonstrating that the proposed payload to be flown aboard the ISS can meet the access and accommodation requirements for ISS payloads. This ISS Letter of Feasibility Assessment must contain: (1) a preliminary assessment of the feasibility of proposed provisions for access to and accommodation on the ISS, (2) identification of known technical interface challenges and/or conditional provisions for access or accommodation, and (3) a description of the level of technical interchange and negotiation required to mature the proposed provisions for access and accommodation.

Proposers requiring an ISS Letter of Technical Interface and Resource Accommodation Feasibility Assessment should contact:

Dr. George C. Nelson
ISS Research Integration Office/Mail Stop OZ
Johnson Space Center
National Aeronautics and Space Administration
Houston, TX 77058
Telephone: 281-244-8514
E-mail: george.nelson-1@nasa.gov

Note that the issuance of the ISS Letter of Technical Interface and Resource Accommodation Feasibility Assessment can take several weeks; therefore, proposers are urged to contact the ISS Research Integration Office as early as possible for such request.

Additional information is found through the *International Space Station Capabilities and Payload Accommodations* document link in the Program Library. For any selected investigations, flight commitment to the ISS will be negotiated with NASA's Human Exploration and Operations Mission Directorate during Phase A. Selection of any investigation to be flown aboard the ISS is conditional until negotiations for ISS access and accommodation are successfully completed.

An Astrophysics Explorers MO investigation that is a SCM to the International Space Station should plan to complete its primary mission investigations by the end of FY 2024. NASA currently plans to operate ISS thru FY 2024, and while the agency is taking no action that would preclude operation beyond FY 2024, no commitment has yet been made either way.

4.6.3.2 *Investigations on High-Altitude Scientific Balloons*

SCMs may be proposed for flight on high-altitude scientific balloons. SCMs on high-altitude scientific balloons must be proposed for flight on Long Duration Balloons (LDBs) or Super Pressure Balloons (SPBs).

Requirement R-22. Proposals for SCM investigations on high-altitude scientific balloons must be proposed for flight on Long Duration Balloons (LDBs) or Super Pressure Balloons (SPBs).

Investigations requiring flight on LDBs or SPBs must provide a Letter of Feasibility from the NASA Balloon Program Office.

Requirement R-23. In addition to the requirements given in the SALMON-2 AO, all SCM investigations requiring flight on high-altitude scientific balloons must also provide a Letter of Feasibility from the NASA Balloon Program Office demonstrating that the proposed payload to be flown aboard LDBs or SPBs can meet the access and accommodation requirements for balloon payloads. This Letter of Feasibility must contain: (1) a preliminary assessment of the feasibility of proposed provisions for access to and accommodation on LDBs or SPBs, (2) identification of known challenges and/or conditional provisions for access or accommodation, and (3) a description of the level of technical interchange and negotiation required to mature the proposed provisions for access and accommodation.

Proposers requiring a NASA Balloon Program Office Letter of Feasibility should contact:

Debora Fairbrother
National Aeronautics and Space Administration
Balloon Program Office/Code 820
Wallops Flight Facility
Wallops Island, VA 23337

Telephone: 757-824-1453

E-mail: debor.a.fairbrother@nasa.gov

Additional information is found through the *Scientific Balloon Missions of Opportunity* document link in the Program Library. For any selected investigations, flight commitment to LDBs or SPBs will be negotiated with the NASA Balloon Program Office during Phase A. Selection of any investigation to be flown aboard LDBs or SPBs is conditional until negotiations for access and accommodation are successfully completed.

4.6.3.3 *Investigations as a CubeSat*

A SCM may be proposed for flight as a CubeSat. NASA has a CubeSat Launch Initiative (CSLI) and regularly provides launch opportunities for CubeSats as secondary payloads on U.S. Government missions. The CubeSat Launch Initiative (CSLI) is managed by the NASA Human Exploration and Operations Mission Directorate. See http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html.

For CubeSat proposals, all instruments/small satellites are recommended to comply with Cal Poly CubeSat Developer's specifications, found at <http://www.cubesat.org/resources/>. Concepts that do not comply with the Cal Poly CubeSat and Poly Picosat Orbital Deployer (P-POD) standards should clearly describe how their designs are packaged and deployed. NASA Launch Services Program has issued a *Program Level Dispenser and CubeSat Requirements Document* with requirements for CubeSats sized up to 6U (2U x 3U). All proposals for CubeSats sized up to 6U shall be compliant with these requirements. These documents can also be found in the Program Library. No CubeSat form factors larger than 6U will be considered under the present solicitation. Qualifying CubeSat form factors (size) include 1U, 1.5U, 2U, 3U, and 6U. Refer to the *LSP Small Payload Access to Space Catalog* in the Program library for the mass limitations.

Requirement R-24. All proposals involving sizes 1U through 6U CubeSats shall be compliant with the requirements in the NASA Launch Services Program's *Program Level Dispenser and CubeSat Requirements Document*. No CubeSat form factors larger than 6U will be considered under the present solicitation. Qualifying CubeSat form factors (size) include 1U, 1.5U, 2U, 3U, and 6U. Refer to the *LSP Small Payload Access to Space Catalog* in the Program library for the mass limitations.

For further information, please contact:

Anne E. Sweet
Launch Services Program Executive
NASA Headquarters
Washington, DC 20546
Phone: 202-358-3784
E-mail: anne.sweet-1@nasa.gov

or

Jason C. Crusan
Director, Advanced Exploration Systems
NASA Headquarters
Washington, DC 20546

Phone: 202-358-0635

E-mail: jason.crusan@nasa.gov

4.6.3.4 *Investigations on suborbital Reusable Launch Vehicles*

SCMs may be proposed for flight on suborbital Reusable Launch Vehicles (sRLVs). Access to sRLV platforms is managed by the Flight Opportunities Program within the Space Technology Mission Directorate. Information about sRLVs is available from the Flight Opportunities Program website at <http://flightopportunities.nasa.gov>. Additional information on sRLV vehicles, including general vehicle capabilities and contact information for some vendors, is available at <http://flightopportunities.nasa.gov/platforms>. The Flight Opportunities Program may advise proposers on the use of sRLV platforms, including the potential integration, safety and mission assurance, and operational costs. Proposers interested in using sRLVs must identify a vehicle that can provide the technical capabilities required to conduct the proposed investigation. SCMs to be flown on sRLVs must either be automated or remotely operated. Remote operation capability must be confirmed with the flight operator.

Requirement R-25. Proposals for investigations using sRLVs as platforms must specify the technical requirements that their investigation places on the vehicle. The proposal must include a Letter of Endorsement from a commercial vendor that (i) provides technical information on how the vehicle will meet the investigation requirements, (ii) states that the vehicle will be available for use at the time proposed for flight and provides information showing a plan for getting from the current vehicle status to flight status, and (iii) provides a quoted cost for the flight and all other services that are required from the vehicle vendor to enable and conduct the proposed investigation. Note that the Flight Opportunities Program is available to assist with (i) – (iii).

Questions concerning potential sRLV investigations may be addressed to:

Robert L. Yang
Flight Opportunities
Space Technology Mission Directorate
NASA Headquarters
Washington, DC 20546
Telephone: 202-358-0143
E-mail: robert.l.yang@nasa.gov

4.6.3.5 *Investigations on Expendable Launch Vehicles*

SCMs larger than CubeSats may be proposed for flight on an ELV. The proposal must specify whether the access to space is to be provided by NASA, for which a charge against the PI-Managed Mission Cost must be included, or secured by the PI. Accommodations on NASA-provided access to space could come in various forms, including as a secondary payload on an Evolved Expendable Launch Vehicle (EELV) Secondary Payload Adapter (ESPA) ring, ESPA Grande, Aft Bulkhead Carrier (ABC), and C-Adapter Platform (CAP), or as a primary payload utilizing Venture Class Launch Services. Compatibility to multiple platforms is encouraged to provide flexibility in manifesting. For additional information on the applicable platforms and charges to the PI-Managed Mission Cost for this solicitation, see the *Launch Services Program Small Payload Access to Space Catalog* in the Program Library.

4.6.4 Risk Classification

This opportunity solicits proposals for science investigations requiring the development and operation of space-based investigations. The projects are designated as Category 3 as defined in NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*. The payloads are designated as Class D as defined in NPR 8705.4, Risk Classification for NASA Payloads, except for PMOs, which depend on host mission's risk classification requirements.

Requirement R-26. If any requirements to the proposed hardware that are more stringent than Class D (as appropriate) are needed, they must be clearly described in the proposal.

4.6.5 End-of-Mission Spacecraft Disposal

[Any requirements in this section or the referenced section of the SALMON-2 AO will apply to Step 2 Concept Study Reports, but do not apply to Step 1 proposals.] Section 5.3.10 of the SALMON-2 AO discusses the requirements related to end-of-mission spacecraft disposal for PMOs and hosted payloads where the PI is not responsible for the host mission. For these proposals, information shall be included regarding the plan for instrument passivation at the end of operations or in preparation for end-of-mission disposal. In addition, information shall be provided identifying instrument system components expected to survive Earth reentry if this is the postmission disposal method. This will allow NASA to remain in compliance with NPR 8715.6A, NASA Procedural Requirements for Limiting Orbital Debris, and NASA-STD-8719.14A, Process for Limiting Orbital Debris.

Requirement R-27. Proposals shall describe the instrument passivation plan at the end of the mission. In addition, proposals shall identify instrument components anticipated to survive Earth reentry if this is the disposal method. This supersedes Requirement 39 in the SALMON-2 AO. However, Requirement 39 in the SALMON-2 AO shall be met for CubeSat proposals.

4.6.6 Science Data Policy

4.6.6.1 Data Analysis

The PI will be responsible for analysis of the investigation data necessary to achieve the proposed science objectives, for archiving the data in the relevant NASA astrophysics data archive for public use, and for timely publication of initial scientific results in refereed scientific journals, as part of their mission operations (Phase E) or postmission (Phase F) activities. Proposals must allocate sufficient resources for this data analysis and archiving. Science studies with the archived data sets beyond the PI-led teams proposed science investigation will be solicited and selected by NASA in subsequent NASA solicitations through ROSES NRAs.

Requirement R-28. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final on-orbit calibration and validation of the measurements. In accordance with the SMD requirement for open data and related software, any specialized software and algorithms required for basic data

analysis and processing will be made available by the PI to the science community and public.

Requirement R-29. Proposals shall clearly present a plan for analysis of the mission data leading to completion of the proposed science investigation and achieving the identified investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.6.6.2 *Data Rights*

By NASA policy, all science data returned from NASA investigations led by a NASA-funded PI are made available immediately in the public domain. Following a postflight checkout period, all data will be made available to the user community. There shall be no period of exclusive access. The Principal Investigator will propose the data product latency period for standard products listed in the proposal, and a justification for it must be demonstrated. Barring exceptional circumstances, data product latency may not exceed six months.

Requirement R-30. Proposals shall include a clear commitment to minimizing the latency for data products. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.6.6.3 *Delivery of Data to Archive*

Mission data will be made fully available to the public by the investigator team in usable form, in the minimum time necessary and, in any case, within the proposed data latency period not to exceed six months following data receipt from the spacecraft. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to making it fully available. By the investigation closeout, the investigation will deliver to the appropriate astrophysics data center all final data products, along with the scientific algorithm software, coefficients, ancillary data used to generate these products, and the algorithm and calibration documentation.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in flight), documentation, related software, and/or other tools or parameters that are necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large and provided within the proposed data latency period, not to exceed six months following data receipt from the spacecraft.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of the appropriate NASA data archive.

Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the capped PI-Managed Investigation Cost.

[The following requirement will apply to the Step 2 Concept Study Report, but does not apply to Step 1 proposals.]

Requirement R-31. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving shall be described. The science products (e.g., flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the formats and standards to be used. It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community.

4.6.6.4 *Sharing of Data from Partner Mission of Opportunity Investigations*

The data that are returned from Partner Mission of Opportunity (PMO) investigations, at least from those aspects of the mission in which NASA is involved, shall be made available to the U.S. scientific community in a timely manner.

Requirement R-32. In addition to the requirements given in the SALMON-2 AO, all proposed PMO investigations must also provide: (1) a detailed description of the proposed provisions for sharing of science data, plans for returned scientific data, at least from those aspects of the mission in which NASA is involved, shall be made available to the U.S. scientific community in a timely manner, and the status of the host mission sponsoring agency's commitment to enter into an appropriate agreement with NASA for data sharing; and (2) a detailed explanation of how the U.S. astrophysics science community benefits from the proposed investigation.

4.7 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are referenced in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.5.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirements and constraints for that specific solicitation, including the sponsoring NASA Headquarters (HQ) mission directorate and division, the type of MO, the Cost Cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2, the Cost Cap is specified in Section 4.5.1, and the schedule constraint is specified in Section 4.5.2.

- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. For this PEA, the NASA Center for program office and the safety, reliability, and quality assurance document applicable to selected investigations are specified in Section 2.3.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the payload risk classification is specified in Section 4.6.4.
- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation by Aerospace in proposals. For this PEA, Section 4.1 states that there are no additional restrictions on participation by Aerospace in proposals.
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Mission Cost, the Total Mission Cost, and the Enhanced Mission Cost. For this PEA, that information is specified in Section 4.5.1. Only the PI-Managed Mission Cost is capped.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.5.1 and 4.5.2.
- Section 4.6 of the SALMON-2 AO states that each PEA will identify any NASA-provided launch services. For this PEA, NASA plans for access to space are discussed in Section 4.5.3.
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Sections 1.3 and 3 that a two-step competitive process is being used.
- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an Education and Public Outreach program that is consistent with SMD policy is required. This PEA does not require an Education and Public Outreach program; therefore, Requirements 69 and 70 of the SALMON-2 AO do not apply to this PEA. However, NASA may impose Education and Communications requirements during or subsequent to the Phase A concept study phase.
- Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA.
- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by SMD and it does not permit contributions of funding from SMD programs other than the funding offered through this PEA.
- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection Official. This PEA identifies the Selection Official in Section 6.2.

4.8 Exceptions to General SALMON-2 Requirements

This PEA contains the following exceptions to the SALMON-2 proposal preparation and submission requirements described in the SALMON-2 AO.

- Requirement R-40 states that proposals or portions of proposals requesting NASA funding shall report proposal costs in FY 2017 dollars. This is for determining compliance with the

PI-Managed Mission Cost Cap requirement. This instruction supersedes the request for costs only in RY dollars described in Appendix B of the SALMON-2 AO including Table B3b.

- Section 4.1.1 concerning the NASA Center role in communications and outreach supersedes Section 4.1.3 of the SALMON-2 AO.
- Requirement R-6, Requirement R-7, and Requirement R-8 are additional requirements to those of Section 5.3.6 of the SALMON-2 AO concerning telecommunications, tracking, and navigation.
- Section 4.5.4 concerning full cost accounting for NASA facilities and personnel supersedes Section 5.5.5 of the SALMON-2 AO.
- Section 4.6.5 provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO. Any proposal requirements for a detailed disposal plan will apply to the Step 2 Concept Study, but do not apply to Step 1 proposals.
- Section 4.6.6 provides data policies and requirements that supersede those in Section 4.4 of the SALMON-2 AO. Any proposal requirements for a schedule-based end-to-end data management plan will apply to the Step 2 Concept Study, but do not apply to Step 1 proposals.
- Requirement R-35 supersedes Requirement B-4 of the SALMON-2 AO and clarifies the information requested on page limits.
- The Heritage Appendix is limited in length. See Requirement R-35. This supersedes the table on Proposal Structure and Page Limits on page B-2 of the SALMON-2 AO.
- Section 5.2.5 of the SALMON-2 AO describes Science Enhancement Options (SEOs) for proposed investigations. Any proposal requirements for SEOs will apply to the Step 2 Concept Study, but do not apply to Step 1 proposals.

5 PROPOSAL PREPARATION AND SUBMISSION

5.1 Proposal Content Requirements

Requirement R-33. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO.

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA reviewers.

The key data associated with the electronic submission of proposals (see Section 6.2 of the SALMON-2 AO) includes questions indicating whether or not a proposal contains export-controlled information (see Sections 5.9.4 and 5.10.2 of the SALMON-2 AO). All proposers must answer these questions YES or NO when completing the electronic submission; these questions shall not be left unanswered.

All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO. To the extent possible, ITAR sensitive material should be organized into separate clearly marked sections.

Requirement R-34. All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO.

The following Requirement supersedes Requirement B-4 of the SALMON-2 AO and clarifies the information concerning page limits.

Requirement R-35. Proposals shall conform to the page limits specified in the *Proposal Structure and Page Limits* table, except that the Heritage Appendix is limited to 30 pages. Two extra pages each are allotted for each additional separate nonidentical science instrument in the Science Section (Sections D and E), two extra pages each are allotted for each additional separate, nonidentical flight element (e.g., additional spacecraft are allotted two extra pages, but only nonidentical spacecraft) in the Mission Implementation and Management Sections (Sections F and G), and two extra pages are allotted for all science enhancement options (SEOs) combined in the Science Implementation Section (Section E). The total number of such extra pages in the Science and Mission Implementation sections combined shall not exceed a maximum of ten extra pages regardless of the number of science instruments and unique flight elements. Every page upon which printing appears will count against the page limits and, unless specifically exempted (e.g., Requirement B-30 and Requirement B-53 of the SALMON-2 AO), each foldout page will count as two pages against the page limits as appropriate for its area (e.g., a fold-out with the total area of two standard pages counts as two pages, etc.).

The following Requirement supersedes Requirement B-15 of the SALMON-2 AO. It clarifies the information requested on the traceability of the proposed investigation, e.g., instrument performance requirements. A modified template is available in the Program Library to assist proposers on presentation of the investigation traceability.

Requirement R-36. Traceability from science goals to measurement requirements to instrument functional and performance requirements and to top-level mission requirements shall be provided in tabular form and supported by narrative discussion. Instrument projected performance shall be compared to the instrument performance requirements.

The following Requirement supersedes Requirement B-23 of the SALMON-2 AO and clarifies the information requested on instrument resource margins.

Requirement R-37. Instrument Contingencies and Margins: This section shall summarize contingencies and margins of all instrument resources. It shall provide estimates of implementation design margins with respect to the required performance or allocations for mass, power, data storage, telemetry, and any other resource requirements. Discuss the allocation of contingency and margin to the instrument and/or suite (see SALMON-2 AO for definitions of contingency and margin).

The following Requirement supersedes Requirement B-24 of the SALMON-2 AO and clarifies the information requested on instrument performance margins.

Requirement R-38. Performance Margins: For each instrument performance, this section shall provide estimates of performance margin with respect to the performance requirements as compared to projected performance estimates and shall justify that these performance margins are appropriate.

The following Requirement supersedes requirement B-27 of the SALMON-2 AO and clarifies the information requested on new technologies and/or advanced engineering development.

Requirement R-39. This section shall describe any proposed new technologies and/or advanced engineering developments and the approaches that will be taken to reduce associated risks. Descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed system (level 3 WBS payload developments and level 3 WBS spacecraft elements) incorporating new technology and/or advanced engineering development at the time the proposal is submitted (for *TRL definitions*, see NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*, Appendix E, in the Program Library);
- Rationale for combining the TRL values of components and subsystems to derive each full system TRL as proposed, appropriately considering TRL states of integration (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*);
- Rationale for the stated TRL value of an element that is an adaptation of an existing element of known TRL;
- The approach for maturing each of the proposed systems to a minimum of TRL 6 by PDR:
 - Demonstration (testing) in a relevant environment can be accomplished at the system level or at lower level(s);
 - If applicable, justify what demonstration(s) in a relevant environment at lower level(s) (subsystem and/or subsystem-to-subsystem) would be sufficient to meet system level TRL 6, considering (i) where any new technology is to be inserted, (ii) the magnitude of engineering development to integrate elements, (iii) any inherent interdependencies between elements (e.g., critical alignments), and/or (iv) the complexity of interfaces – see the Program Library for examples;
 - Include discussion of simulations, prototyping, demonstration in a relevant environment, life testing, etc., as appropriate;
- An estimate of the resources (manpower, cost, and schedule) required to complete the technology and/or advanced engineering development; and
- Approaches to fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance liens they impose on the baseline design, and the decision milestones for their implementation.

If no new technologies or advanced engineering development is required, system TRL 6 or above at the time of proposal submission shall be clearly demonstrated.

Requirement R-40. Proposals or portions of proposals requesting NASA funding shall report proposal costs in FY 2017 dollars.

5.2 Proposal Submission Requirements

Requirement R-41. Proposals must be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES), at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only.

Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement R-42. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

Requirement R-43. In addition to electronic submission, two identical, clearly labeled CD-ROMs that contain electronic proposal file(s) and Microsoft Excel files of tables (B1, B2, B3b and B5) and the Proposal Conflicted Party List (see Requirement R-44), shall be delivered to the following address by the proposal submittal deadline specified in Section 7.

NASA Research and Education Support Services (NRESS)
Suite 500
2345 Crystal Drive
Arlington, VA 22202

Telephone for commercial delivery: 202-479-9030

Requirement R-44. A table of Proposal Participants shall be provided. The table shall include all individuals and organizations named in the proposal or who have participated in the proposal preparation, including participation as a proposal writer, Red Team member, reviewer, etc. Additionally, the table shall include all institutions with interests in the mission, including major partners, contributors, or vendors. The primary purpose of the table is to aid NASA in avoiding conflicts of interest during the evaluation of the proposal. A secondary purpose is to provide material helpful for the evaluation and selection process. The Proposal Participants information shall be provided as a Microsoft Excel spreadsheet document on each CD-ROM submitted with the proposal. The Microsoft Excel spreadsheet template that has been posted to the Program Library with the name *Proposal Conflicted Party List* shall be used.

5.3 Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this PEA, or in the documents available through the Program Library, should be sent to the E-mail address for questions listed in Section 7 of this PEA. Responses that are helpful and informative to proposers will be posted on the website listed in Section 7 of this PEA. Anonymity of the authors of all questions will be preserved.

The deadline for receipt of questions is two weeks before the proposal due date listed in Section 7 of this PEA.

6 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

In addition to the evaluation criteria given in Section 7.2.3 of the SALMON-2 AO, the evaluation of the *Experiment Science Implementation Merit and Feasibility of the Investigation* also includes the following additions to Factors B-2 and B-3:

- Factor B-2, Probability of technical success, also includes the maturity and technical readiness of the instruments or demonstration of a clear path to achieve the necessary maturity.
- Factor B-3, Merit of the data analysis, data availability, and data archiving plan. This factor includes the merit of plans for data analysis and data archiving to meet the goals and objectives of the investigation.

In addition to the evaluation criteria given in Section 7.2.4 of the SALMON-2 AO, the evaluation of the *TMC Feasibility of the Investigation Implementation, including Cost Risk* also includes the following additions to Factors C-1 and C-3:

- Factor C-1, an assessment of plans for the development and use of new instrument technology, plans for advanced engineering developments, and the adequacy of backup plans to mature systems within the proposed cost and schedule when systems having a TRL less than 6 are proposed.
- Factor C-3, plans for the development and use of new technology, plans for advanced engineering developments, and the adequacy of backup plans to ensure success of the mission when systems having a TRL less than 6 are proposed.

6.2 Selection Process

After the review by the SMD AO Steering Committee, the evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the final selection(s). As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency, including the Director of the Astrophysics Division, concerning the selections.

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among top-rated proposals, including, but not limited to, planning and policy

considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the mission directorate(s).

6.3 Implementation Activities

Proposal selection and award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO with the following amendments.

6.3.1 Principal Investigator-led Team Masters Forum

One step toward successful execution of PI-led missions is to ensure that PI-led mission management teams receive the instruction necessary to enable them to better execute their missions for NASA. SMD, in conjunction with the NASA Academy of Program, Project, and Systems Engineering Leadership (APPEL), has established a 2.5 day PI-led Team Masters Forum for newly selected PI-led mission management teams. The purpose of the PI-led Team Masters Forum is to facilitate knowledge sharing in areas that are deemed necessary to successfully execute PI-led SMD science missions. Course attendance by the leaders of newly selected PI-led mission management teams (PI, Project Manager, Project Scientist, and Project Systems Engineer) and the NASA Headquarters Program Scientist and Program Executive (where assigned) is required as soon as practical after proposal selection.

6.3.2 Award Administration and Funding of Investigations

Oversight management responsibilities have been assigned to the Explorers Program Office at the Goddard Space Flight Center. The responsibilities of the Program Office will include oversight of investigation implementation; coordination of Government-furnished services, equipment and facilities; and contract management for selected investigations.

It is anticipated that the Program Office will provide funding to each selected investigation. This award to perform a Phase A concept study is to be initiated as soon as possible after notification of selection. NASA Centers will receive funding via intraagency funding mechanisms. In order to place Phase A awards in place, Statements of Work (SOWs), certified cost and pricing data, and small business subcontracting plans will be required for the Phase A concept studies.

Proposals are not required to include SOWs, cost and pricing data for Phase A concept studies and subsequent phases, or small business subcontracting plans. These will be required only for investigations that are selected at the outcome of the Step-1 competition. If more than one contractual arrangement between NASA and the proposing team is required, a separate SOW will be required for each organization.

For those investigations that are selected, it will be in the best interest of their PI-led mission management teams to provide SOWs, cost and pricing data, and small business subcontracting plans in as timely a manner as possible. The process of awarding contracts cannot begin until SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed.

SOWs will be required for selected investigations regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the requirement for a Phase A Concept Study Report as described in the *Guidelines and Criteria for the Phase A Concept Study* document available in the Program Library, as well as general task statements for Phases B through F. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). SOWs need not be more than a few pages in length.

Each Phase A contract will contain a priced option for a Bridge Phase, to be exercised upon investigations down-selected to proceed into Phase B. The Bridge Phase option will allow work to be continued uninterrupted under the contract after a Step-2 downselection decision is made. The Bridge Phase is intended to cover a four-month period of Phase B effort to provide program continuity while negotiations are completed to modify the contract to include Phases B, C/D, and E/F. The Bridge Phase Option will be exercised only on the contract for the investigation that is chosen during the Step-2 downselection process to continue beyond the Phase A concept study. The Bridge Phase option will allow the Government to continue work under the contract after a Step-2 downselection decision is made. Additional phases will be added to the contract after each phase has been approved through the program review process. The four-month Bridge Phase period will be used to begin the negotiation of the remaining phases of the contract with the successful PI downselected following Phase A.

6.3.3 Conduct of the Phase A Concept Study

The concept studies are intended to provide NASA with more definitive information regarding the cost, risk, and feasibility of the investigations, as well as a detailed plan for the conduct of any optional student collaboration, before final selection for implementation. The product of the concept studies is a Phase A Concept Study Report to be delivered by each selected investigation team nine months following the establishment of initial contracts. The content and format of the study reports are specified in the *Guidelines and Criteria for the Phase A Concept Study* document in the Program Library.

The PI will provide in the Phase A Concept Study Report a proposed set of Level 1 requirements, including the criteria for full investigation success satisfying the Baseline Science Investigation and the criteria for minimum investigation success satisfying the Threshold Science Investigation. The PI will also provide in the Phase A Concept Study Report the allocation of the proposed cost reserves among the appropriate WBS elements. The PI-Managed Mission Cost will not increase by more than 20% from that in the Step-1 proposal to that in the Phase A Concept Study Report, and, in any case, will not exceed the AO Cost Cap. The NASA review of the completed Concept Study Report will include all investigation facets. Risk reduction that has been accomplished during Phase A will be closely reviewed. NASA may request presentations and/or site visits to review the final concept study results with the investigators.

Each investigation's Concept Study Report must conclude with a commitment by the PI for the cost, schedule, and scientific performance of the investigation. For each Phase B selection, and unless otherwise stated in the selection letter, the selected investigation's cost will be set at the Concept Study Report's proposed cost.

NASA cannot guarantee that the proposed funding profile can be accommodated within the Astrophysics Explorers Program's budget. A funding profile for the selected investigation will be negotiated during Phase B.

6.3.4 Downselection of Investigations

The SMD Associate Administrator will make downselection decisions based on the evaluation of the Phase A Concept Study Reports and on programmatic considerations. The criteria for evaluating the concept study are as follows:

1. Scientific merit of the proposed investigation;
2. Science implementation merit and feasibility of the investigation;
3. Technical, management, and cost feasibility of the investigation implementation, including cost risk; and
4. Quality of plans for small business subcontracting plans and optional student collaboration, if proposed.

The evaluation criteria and downselection factors are described in the *Guidelines and Criteria for the Phase A Concept Study* document that will be available in the Program Library. Any substantial changes to science contained in the Phase A Concept Study Report will result in its reevaluation: if no substantial changes are found to have been made to science, the Step-1 evaluation of the first criterion will be maintained.

Proposers may be asked for specific information at the time of selection for a competitive Phase A. This requested information will need to be included in the Phase A Concept Study Report and will be considered at the time of downselection for flight.

At the conclusion of Phase A, it is anticipated that the Selecting Official will continue one or two investigations into the subsequent phases of mission development for flight and operation. The target date for this continuation decision (i.e., downselection) is given in Section 7.

An investigation may be downselected to enter Phase B or may be downselected for a funded Extended Phase A so they can retire one or more risks before they are allowed to proceed to Phase B. There is no guarantee that an investigation downselected for an Extended Phase A will be approved to enter Phase B, even if all risks have been retired during the Extended Phase A.

Upon a continuation decision, NASA will execute the Bridge Phase option and begin to provide additional funding for the project that is continued beyond the Phase A concept study. During the Bridge Phase, NASA and the continued project will negotiate and sign a contract modification necessary for the remaining portion of mission phases. Deliverables will be negotiated during the Bridge Phase, on the basis of information provided in the Concept Study Report.

In no case is NASA required to exercise any option. NASA will not exercise any contract option nor continue funding those investigations not selected to proceed. For those investigations that are not continued, the contracts will be allowed to terminate without further expense to NASA.

Every investigation team will be offered a debriefing of the evaluations of its Concept Study Report.

6.3.5 *International Agreements*

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, the Science Division of NASA's Office of International and Interagency Relations will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail an exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency MOU. For additional policies and requirements, see Section 5.9 of the SALMON-2 AO.

7 SUMMARY OF KEY INFORMATION

Funding available	See Section 4.5.1 of this PEA
Community Announcement	December 15, 2015
Release of Draft PEA Date	July 21, 2016
Comments Due on Draft PEA	August 11, 2016
Final PEA Release Date	September 15, 2016
Date for Preproposal Conference	October 6, 2016
[Amended October 21, 2016]	
Due Date for NOI (notice of intent to propose)	October 27, 2016
Due Date for NOI (notice of intent to propose)	October 13, 2016
Due Date for Proposals	December 15, 2016
Due Date for Receipt of CD-ROMs with Proposal and Tables	December 20, 2016, 5:00 p.m. Eastern Time
Selection Date for Competitive Phase A Studies	Summer 2017
Concept Study Reports Due	Spring 2018
Down-Selection Date	Early 2019
Web site for additional information for the Astrophysics Explorers MO PEA	http://explorers.larc.nasa.gov/APMIDEX2016/MO/index.html

Program Library for the Astrophysics Explorers PEA	http://explorers.larc.nasa.gov/APMIDEX2016/MO/programlibrary.html
Proposal Submission Medium	Electronic submission via NSPIRES, see Section 5.2 of this PEA; also two copies via CD-ROM, see Section 5.2 of this PEA.
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)
NASA point of contact	Dr. Wilton Sanders Astrophysics Explorers Program Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-1319 E-mail: wilton.t.sanders@nasa.gov

END OF PEA R

NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)
NNH12ZDA0060-EVI4
PROGRAM ELEMENT APPENDIX (PEA) S:
EARTH VENTURE INSTRUMENT (EVI)-4

NOTICE: Clarified August 16, 2016. The letter designation for several of the requirements in this Program Element Appendix have been corrected. They were incorrectly identified as “Requirement T-“, rather than “Requirement S-“. New letters are in bold; old, incorrect letters are struckthrough. The numbering remains unchanged.

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PROGRAM ELEMENT APPENDIX (PEA) S:
EARTH VENTURE INSTRUMENT (EVI)-4
NNH12ZDA006O
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)

1 BACKGROUND

1.1 Programmatic Overview

The National Aeronautics and Space Administration (NASA) Science Mission Directorate (SMD) Earth Science Division's Earth Venture (EV) mission portfolio is an element within the Earth System Science Pathfinder (ESSP) Program. Earth Venture missions consist of a series of regularly solicited, competitively selected, cost and schedule constrained Earth science investigations as recommended by the most recent National Research Council's decadal survey in Earth science, *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (The National Academies Press, 2007), available at http://www.nap.edu/catalog.php?record_id=11820.

The goal of NASA's Earth Venture mission portfolio is to provide frequent flight opportunities for high quality, high value, focused Earth science investigations that can be accomplished under a not-to-exceed cost cap and that can be developed and flown relatively quickly, generally in five years. The investigations will be Principal Investigator (PI) led and will be selected through an open competition to ensure broad community involvement and encourage innovative approaches.

The programmatic objectives of the Earth Venture mission portfolio are to implement missions that will:

- advance scientific knowledge of Earth science processes and systems;
- add scientific data and other knowledge-based products to data archives for all to access;
- result in scientific progress and results published in the peer-reviewed literature to encourage, to the maximum extent possible, the fullest commercial use of the knowledge gained;
- provide opportunities to expand the pool of well-qualified Principal Investigators and Project Managers for implementation of future NASA missions;
- implement technology advancements accomplished through related programs; and
- communicate scientific progress and results through popular media, scholastic curricula, and outreach materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

The EV investigations will accomplish high quality Earth science investigations utilizing efficient management approaches to contain mission cost through commitment to, and control of, design, development, and operations costs.

This solicitation calls for proposals for complete PI-led science investigations requiring spaceflight instrument or CubeSat(s) development. The term "complete" encompasses

investigation phases from project initiation, through development and science operations, to scientific analysis of space based data. These spaceflight missions will be used to conduct innovative, integrated, hypothesis or scientific question-driven investigations addressing pressing Earth system science issues.

This solicitation calls for investigations addressing any of the science goals in NASA's Earth Science program (see Section 2.1 for a description of the science goals). Investigations may target any Earth science question or issue in order to advance the strategic goals outlined in Section 2.1, answer any of the science questions for Earth Science from Section 2.1 of this PEA and the *2014 Science Mission Directorate Science Plan* (hereafter referred to as the *2014 Science Plan*; available at <http://science.nasa.gov/about-us/science-strategy/>), or address any of the science goals for Earth Science also from the *2014 Science Plan*.

Investigations that address NASA goals in other areas such as heliophysics, astrophysics, or planetary science are not solicited in this PEA. Priority will be given to cost-effective, innovative investigations with demonstrable reliability, rather than ones with excessive technology development requirements. Investigations that focus on establishing entirely new research avenues or demonstrating key applications-oriented measurements are solicited.

A key to the success of the Earth Venture portfolio will be maintaining a steady and predictable stream of opportunities for community participation and innovative idea development. This requires that strict schedule and cost guidelines be enforced on the selected EV missions and mission teams.

1.2 Earth Venture Background

The National Research Council's decadal survey in Earth science recommended that NASA maintain a line of competitively selected, moderate size missions and opportunities in the Earth Venture mission portfolio. Six solicitations/selections have already resulted from the NASA Earth Venture program. Earth Venture is being implemented in the broader context of NASA's Earth Science program and has resulted in more frequent opportunities than afforded by the strategic and directed missions outlined in the decadal survey.

The following foci have been identified for the Earth Venture-class missions:

- measurement and observation innovations;
- demonstration of innovative ideas allowing the use of existing moderately higher-risk technologies or approaches;
- establishment of new research avenues; and
- possible demonstration of key application-oriented measurements.

The selection criteria for EV missions are based primarily on the direct science return from the measurement.

The National Research Council's decadal survey in Earth science and applications has recommended three types of Earth Venture-class missions. Through the Earth Venture mission

portfolio, NASA intends to obtain a mix of suborbital, instrument, and complete spaceflight mission investigations. To achieve this mix, three different kinds of solicitations are being pursued under the Earth Venture-class line.

- *EV Suborbital* (i.e., EVS-1, 2, 3, ...). These solicitations call for proposals for complete suborbital, PI-led investigations to conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The first suborbital science investigations funded under the EV-1 element (or EVS-1 by the new EV naming scheme) are now completed. Under EVS-2 solicitation, the second one of this series, investigations are now in operations. This is not solicited in this SALMON-2 PEA.
- *EV-Mission* (i.e., EVM-1, 2, 3, ...). These solicitations call for proposals for complete PI-led spaceflight missions to conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The EV-2 (or EVM-1 by the new EV naming scheme) solicitation was the first of this series, with the selected mission now in development. The second solicitation in this series, EVM-2, is expected to announce a selection in FY16. This is not solicited in this SALMON-2 PEA.
- *EV Instrument* (e.g., EVI-1, 2, 3, ...). These solicitations call for developing instruments for participation on a NASA-arranged spaceflight mission of opportunity or for developing CubeSat(s) to fly on a NASA arranged launch vehicle. These investigations must conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The NASA funded PI will retain a central role on the instrument package or CubeSat(s) development, integration and testing, calibration, and science operations. The EVI-1 solicitation was the first of this series, with the selected mission in development. As a result of the EVI-2 call, two investigations were selected that are now also in development. Two additional investigations were selected as a result of the EVI-3 call. Solicitations in this series are anticipated every 18 months (or shortly after the selection announcement of the previously solicited EVI). EVI-4 is solicited in this SALMON-2 PEA.

All Earth Venture-class spaceflight missions require a schedule for launch (or delivery for platform integration in the case of EVI) within five years of project initiation and projects are cost-capped. The Earth Venture class is not intended to be a mechanism for accelerating the implementation of decadal survey missions. However, it is also possible and acceptable that an instrument selected and developed through this solicitation could address significant portions of missions or measurements identified by the decadal survey.

This is the fourth solicitation in the Earth Venture Instrument series. The fifth solicitation in this series is anticipated to be 18 months after the release of this EVI-4 PEA, but not before the selection announcement for EVI-4.

1.3 Overview of this Program Element Appendix

NASA issues this Program Element Appendix (PEA) as an appendix of the Second Stand Alone Missions of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO) for the purpose of soliciting proposals for Mission of Opportunity (MO) investigations to be

implemented through the Earth Venture Instrument (EVI) element of the Earth System Science Pathfinder (ESSP) Program. All investigations proposed in response to this solicitation must support the goals and objectives of the ESSP Program and the EVI element (Section 2.1) and must be implemented by Principal Investigator (PI) led investigation teams (Section 5.4 of the SALMON-2 AO). Two types of investigations are solicited: Instrument Investigations and CubeSat Investigations.

Instrument Investigations must encompass the provision of a flight qualified spaceflight instrument or instrument package ready for integration to a spacecraft (Phase A-C), the technical support for integration onto a NASA-determined spacecraft (Phase D, see Section 4.4.1), the on-orbit operations, and the delivery of science quality data (Phase E), as described in Section 4.1 of the SALMON-2 AO.

CubeSat Investigations must encompass the provision of CubeSat(s) (instrument and flight systems) ready for integration to the launch vehicle (Phases A-D), the technical support for integration onto a NASA-determined launch vehicle (part of Phase D, see Section 4.4.1), the on-orbit operations, and the delivery of science quality data (Phase E), as described in Section 4.1 of the SALMON-2 AO.

Proposals submitted in response to this SALMON-2 PEA will be evaluated and selected through a single step competitive process. As the outcome of this single step, NASA intends to select at least one proposed investigation to proceed to mission development for flight and operations. If more than one proposal is deemed selectable such that combined costs are within the available funding (as defined in Section 4.4.1), NASA may select more than one investigation in response to this solicitation.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO and this PEA, particularly Section 5.1, contain additional requirements on the format and content of the proposals. Documents available in the EVI-4 Library at http://essp.larc.nasa.gov/EVI-4/evi-4_library.html are intended to provide guidance for proposers; they are specifically not intended to impose requirements on proposals.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 NASA Earth Science Goals

One of NASA's strategic goals is to "Advance understanding of Earth and develop technologies to improve the quality of life on our home planet." Further information on NASA's Strategic Goals may be found in NASA Policy Directive (NPD) 1001.0B, *The 2014 NASA Strategic Plan*, available through the EVI-4 Library. The NASA Science Mission Directorate (SMD) is addressing this strategic goal by pursuing the Earth Science Goals.

Our planet is changing on all spatial and temporal scales and studying the Earth as a complex system is essential to understanding the causes and consequences of climate change and other global environmental concerns. The purpose of NASA's Earth science program is to advance our

scientific understanding of Earth as a system and its response to natural and human-induced changes and to improve our ability to predict climate, weather, and natural hazards.

NASA's ability to observe global change on regional scales and conduct research on the causes and consequences of change position it to address the NASA strategic objective for Earth science, which is to advance knowledge of Earth as a system to meet the challenges of environmental change, and to improve life on our planet. NASA addresses the issues and opportunities of climate change and environmental sensitivity by answering the following key science questions through our Earth science program:

- How is the global Earth system changing?
- What causes these changes in the Earth system?
- How will the Earth system change in the future?
- How can Earth system science provide societal benefit?

These science questions translate into seven overarching science goals to guide the Earth Science Division's selection of investigations and other programmatic decisions:

1. Advance the understanding of changes in the Earth's radiation balance, air quality, and the ozone layer that result from changes in atmospheric composition (*Atmospheric Composition*);
2. Improve the capability to predict weather and extreme weather events (*Weather*);
3. Detect and predict changes in Earth's ecological and chemical cycles, including land cover, biodiversity, and the global carbon cycle (*Carbon Cycle and Ecosystems*);
4. Enable better assessment and management of water quality and quantity to accurately predict how the global water cycle evolves in response to climate change (*Water and Energy Cycle*);
5. Improve the ability to predict climate changes by better understanding the roles and interactions of the ocean, atmosphere, land and ice in the climate system (*Climate Variability and Change*);
6. Characterize the dynamics of Earth's surface and interior, improving the capability to assess and respond to natural hazards and extreme events (*Earth Surface and Interior*); and
7. Further the use of Earth system science research to inform decisions and provide benefits to society.

Two foundational documents guide the overall approach to the Earth science program: the National Research Council's (NRC's) 2007 Earth science decadal survey and NASA's 2010 climate-centric architecture plan. The NRC decadal survey articulates the following vision for Earth science research and applications in support of society:

Understanding the complex, changing planet on which we live, how it supports life and how human activities affect its ability to do so in the future is one of the greatest intellectual challenges facing humanity. It is also one of the most important challenges for society as it seeks to achieve prosperity, health, and sustainability.

The 2007 decadal survey recommended a broad portfolio of missions to support the research that is needed to provide answers to the key science questions and accomplish the related science goals. Recognizing the pressing challenge of climate change, NASA addressed the need to ensure the continuity of key climate monitoring measurements in its 2010 climate-centric architecture plan. The plan reflects the need to collect additional key climate monitoring measurements, which are critical to informing policy and action, and which other agencies and international partners had not planned to continue. The plan also accelerated key decadal survey recommendations to address the nation's climate priorities.

NASA's ability to view the Earth from a global perspective enables it to provide a broad, integrated set of uniformly high-quality data covering all parts of the planet. NASA shares this unique knowledge with the global community, including members of the science, Government, industry, education, and policy-maker communities. For example, NASA plays a leadership role in a range of Federal interagency activities, such as the U.S. Global Change Research Program (USGCRP), by providing global observations, research results, and modeling capabilities. It also maintains an expansive network of partnerships with foreign space agencies and international research organizations to conduct activities ranging from data sharing agreements to joint development of satellite missions. These interagency activities and international partnerships substantially leverage NASA's investments and provide knowledge essential for understanding the causes and consequences of climate change and other global environmental concerns.

Further information on the goals and objectives of NASA's Earth Science program may be found in the *2014 Science Mission Directorate Science Plan* available through the EVI-4 Library.

2.2 Accommodation of EV Instruments and Launch of EV CubeSats

The objective of this solicitation is to select one or more Instrument Investigation(s) where an instrument(s) is built and deployed on an existing or planned spacecraft, and/or one or more CubeSat Investigation(s) where CubeSats are developed and ride to space on an available launch vehicle. Both types of investigations must produce high quality and highly useful Earth Science data. Instrument investigations will be proposed without a firm identification of the spacecraft to accommodate these instruments and CubeSat Investigations will face uncertainty about access to space. Therefore, selection of proposals from this solicitation will take into account the "accommodatability" of the proposed instruments and/or the access to space for proposed CubeSats, as well as the value of the science to be returned from the selected investigations.

Many satellites that will be launched to orbits appropriate for observations of the Earth System are expected to have capacity to accommodate Instrument Investigations. These spacecraft could be developed by NASA (including the International Space Station), other U.S. agencies, foreign space agencies, or commercial vendors. In order to take advantage of excess payload capacity on any of these platforms, NASA is planning to have instruments available for inclusion on these various spacecrafts. The available capacity including size, weight, power, thermal control, pointing stability, pointing ability, orbits, and data rates for each potential platform will vary, but, in general, the platform requirements and capacities will be defined by their primary payloads. The instruments provided through this PEA will have to work within the available resources. Hence, there will be some constraints on the specifications of any instruments potentially selected for development through this EVI-4 PEA. Proposed instruments that cannot

meet many of the requirements anticipated for most potential platforms will be seen as a higher risk for accommodation than those that have higher specification margin.

NASA has initiated a CubeSat Launch Initiative (CSLI) and begun regularly providing launch opportunities for CubeSats as secondary payloads on U.S. Government missions. The CubeSat Launch Initiative is managed by the NASA Human Exploration and Operations Mission Directorate; see http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html.

For further information, please contact: Anne E. Sweet, Launch Services Program Executive, Phone: 202-358-3784, E-mail: anne.sweet-1@nasa.gov or, Jason C. Crusan, Chief Technologist for Human Exploration and Operations, Phone: 202-358-0635, E-mail: jason.c.crusan@nasa.gov

2.3 NASA Management of the Earth Venture Program

The selected investigation(s) will be managed by the Earth System Science Pathfinder (ESSP) Program. The Associate Administrator for NASA SMD has established an ESSP Program Office (ESSP PO) at the NASA Langley Research Center (LaRC) to be responsible for project oversight. The ESSP Program Manager at NASA LaRC reports to the Associate Director for Flight Programs within the Earth Science Division at NASA Headquarters. Additional details about the program office staffing, structure, and management approach can be found in the *ESSP Program Plan*, available through the EVI-4 Library. There are appropriate protective firewalls between the ESSP Program Office and the rest of NASA LaRC, allowing investigators from LaRC to propose in response to this PEA. ESSP PO will manage the EVI investigations under the requirements of NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, as described in Section 4.1.2 of the SALMON-2 AO.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

This solicitation is an appendix to the NASA SALMON-2 AO. The SALMON-2 AO provides the overall structure and guidelines for several types of mission of opportunity solicitations. Each new opportunity is announced with a Program Element Appendix (PEA). This document is such a PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com> and at <http://go.nasa.gov/SALMON2-AO>.

This PEA solicits Earth science investigations that include the development of instruments to be provided to and integrated with yet-to-be-identified space platforms and/or the development of CubeSats to be provided to and integrated with yet-to-be-identified launch vehicles.

Evaluation and selection will be done using a single step selection process; no competitive Phase A (Step 2) or down selection is planned. Normal Phase A activities will be conducted by the selected investigation team or teams following selection.

The following schedule applies to this PEA.

- A Preproposal Workshop will take place in association with this solicitation. Further information will be available at the Earth Venture Instrument-4 Acquisition Homepage (see Section 7 of this PEA) prior to the Preproposal Workshop.
- Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA. The period for questions will close two weeks before the proposal due date.
- A Notice of Intent (NOI) to propose to this announcement is **REQUIRED** for this solicitation. It is desired by NASA SMD that all NOIs have the entire investigation team identified within the NOI to allow for the identification of unconflicted evaluators by the proposal due date. SMD requires that proposers communicate any changes to the investigation team between NOI and proposal submission directly to the EVI-4 Program Scientist identified in Section 7 of this PEA. NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Section 6.1.2 of the SALMON-2 AO provides information on electronic NOI submission through NSPIRES. Submitting an NOI does not commit the team to submitting a proposal.
- All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.
- NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four months following receipt of the Statement of Work, as set forth in Section 6.3.1 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Propose

Refer to Section 4.2 of the SALMON-2 AO for the rules on participation policy. For this particular PEA, NASA will place full or partial limitations (as described in the SALMON-2 AO) on organizations that will be involved in the evaluation process. Cornell Technical Services LLC (CTS) is subject to the "Full Limitation" as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on The Aerospace Corporation for EVI-4.

4.2 Type of Mission of Opportunity

In the context of the SALMON-2 AO, this PEA is a Focused Mission of Opportunity (FMO). A FMO is one that addresses a specific, NASA-identified flight opportunity that fulfills the solicited objectives and includes all of the elements specified in this document and in the SALMON-2 AO.

The investigation PI is responsible for conducting the proposed science investigation which includes, but is not limited to: (i) development and delivery of the instrument, instrument package, and/or CubeSat(s); (ii) working with NASA to integrate the instrument on the NASA-chosen platform and/or the complete CubeSat(s) onto the NASA-determined launch vehicle; (iii) commissioning, validating, and operating the instrument and/or CubeSat(s) on-orbit and required ground systems in order to carry out the proposed science investigation; (iv) preparing and delivering appropriate data analysis software, including required calibration data, analyzing the data, archiving all the proposed investigation data at a NASA-chosen Distributed Active

Archive Center (DAAC) for public distribution to the scientific community, and reporting the results of the science investigation in the scientific literature.

4.3 Science Requirements and Constraints

The science goals and questions are fully described in Section 2 of this PEA. Any appropriate science question relevant to Earth system science can be addressed with the proposed investigations. Section 2 provides the basis for the evaluation of intrinsic science merit as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside Earth system science as described in Section 2 are not solicited through this call.

Requirement S-1. Proposals shall address appropriate science goals and questions relevant to Earth system science as described in Section 2 of this PEA.

Requirement S-2. Each proposal shall clearly define its science goals and questions, shall demonstrate how the science questions map into high-level science requirements, and shall show how the science requirements subsequently map into the measurement and instrument performance requirements and for CubeSat Investigations into the CubeSat(s) performance requirements.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement S-3. Each proposal shall clearly state the baseline and threshold requirements for the performance of the instrument and/or CubeSat(s), the prime mission lifetime for operations, and the range of satellite orbits acceptable or required for deployment.

Requirement S-4. Proposals shall designate all Co-Investigators (Co-Is), describe the role of each Co-I in the development of the mission, and justify the necessary nature of the role; see Section 5.6 of the SALMON-2 AO.

Each observation from space has natural synergies with other observations. Some proposed observations may either require or desire additional observations in order to better address the science questions as proposed for the investigation. Some of these observations may be currently existing or planned either from other NASA missions or from missions by other U.S. or non-U.S. agencies. Proposers are expected to clearly state any dependencies on other data sets, what assumptions are made on the likelihood that these observations will exist during potential time frames for operation of their proposed investigations and the implications if those observations do not exist.

Requirement S-5. Each proposal shall clearly outline which additional ongoing or planned observations, if any, are required for the proposed investigation to achieve its baseline mission science investigation. The proposal shall describe how the high-level science requirements will be impacted if such observations do not exist when the proposed investigation is in operation.

Most NASA Earth science observations from space require stringent and well-defined calibration and validation plans. NASA expects each proposal to fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the

selected PI-led investigation, the proposal should provide information about the commitment to funding for those data in the time frame of five to ten years after selection of the investigation and describe the implications to meeting the science requirements if such data do not become available.

Requirement S-6. Each proposal shall fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the selected PI led investigation, the proposal should provide information about the expectations for available calibration and validation instruments and/or data in the time frame of five to ten years after selection of the investigation and describe the implications to meeting the science requirements if such activities do not become available.

4.4 Cost and Schedule Requirements and Constraints

4.4.1 Cost Requirements and Constraints

The PI-Managed Mission Cost Cap for an Earth Venture Instrument investigation depends on the instrument class, as described in Section 4.5.5 of this PEA. For Class D instrument based investigations or for CubeSat based investigations, the cost cap is \$33M in Fiscal Year (FY) 2020 dollars. For Class C instrument based investigations, the cost cap is \$102M in FY 2020 dollars.

NASA expects to select some combination of Class C and Class D investigations based on funding availability at the time of selection, assuming such investigations are deemed selectable.

Each selected investigation is PI-Managed, and the PI will be responsible for defining and controlling the costs within the proposed budget for each phase of the investigation. Since NASA will be arranging the spacecraft for the Instrument Investigation(s) and access to space for CubeSats, some costs cannot be defined and controlled by the PI, and these costs will be outside the constrained PI-Managed Mission Cost. This section identifies those costs that are constrained within the PI-Managed Mission Cost and those where NASA requires planning budgets that are outside the constrained PI-Managed Mission Cost. A summary of budgeted costs that are and are not to be included within the PI-Managed Mission Cost cap for Instrument Investigations is listed in Table 1 and for CubeSat Investigations is listed in Table 2.

The ESSP Program's planning budget can accommodate one or more selection(s) within this solicitation's cost cap with a typical (combined) funding profile over a nominal five-year development period for Class C instrument delivery and a nominal four-year development period for Class D instrument or CubeSat(s) delivery. Proposers should propose a funding profile that is appropriate for their investigation. However, NASA cannot guarantee that every proposed funding profile can be accommodated within the ESSP Program's budget. The inability of NASA to accommodate the requested funding profile may be a reason for nonselection of a proposal. Final funding profiles for all selected investigations will be negotiated between the ESSP Program and the selected investigation teams.

Requirement S-7. Proposals shall be for complete investigations including Phases A-F.

Requirement S-8. The proposed PI-Managed Mission Cost shall be no more than \$102M in FY 2020 dollars for a Class C instrument based investigation. The PI-Managed Mission Cost shall be no more than \$33M in FY 2020 dollars for any Class D instrument or any CubeSat based investigation. The PI-Managed Mission Cost for Instrument Investigations excludes the integration of the instrument to the selected platform and for CubeSat Investigations excludes the integration of the CubeSat to the selected launch vehicle; it also excludes launch services. All proposals shall include the proposed science team, instrument personnel, and key management and engineering staff activity in Phase D. Proposals shall assume two years for Phase D.

Requirement S-9. Proposals shall include detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Mission Cost (see Tables 1 and 2).

4.4.1.1 Instrument Investigation Cost Requirements and Constraints

For Instrument Investigations, costs that are within the PI-Managed Mission Cost include: instrument delivery ready for integration onto the selected platform (Phases A-C); development and delivery of functional algorithms and ground processing system (Phases B-D); supporting a science team that will contribute directly to the successful implementation of the investigation (Phases A-F); required calibration and validation activities (Phases C-E); operations, product generation, and data analysis during the proposed prime mission lifetime of the investigation (Phases E); and close out of the investigation once the investigation has been concluded (Phase F). The PI-Managed Mission Cost also includes the cost of the science team and of key management, instrument, and engineering staff during Phase D, as this is not expected to be dependent on the final platform of the selected investigation. For support of the science team and key management and engineering during Phase D, a two-year duration should be assumed for budgeting purposes.

It is expected that once an appropriate platform is determined (preferably before the Preliminary Design Review) minor changes to the selected instrument will be required. Appropriate budget margin should be planned to account for such changes.

Costs that are outside the PI-Managed Mission Cost include integration to the NASA selected platform (Phase D); and investigation costs during any potential gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D).

For planning purposes, the proposal must include estimates of costs for Phase D (nominally two years) that would be outside the PI-Managed Mission Cost as identified above. It is understood that final Phase D cost will be dependent on the selected platform for the instrument and the actual time frame for each development phase.

NASA also requires proposals to include plans and planning budgets that estimate the minimum costs for the project if there is a gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D). Instrument and essential ground processing/algorithm/science development activities must not be planned during this gap as the instrument must be completed for delivery; only

instrument maintenance activities such as storage and periodic monitoring must be planned. These "gap planning" budgets should be on a per-year basis up to a maximum of four years. The costs for both of these planning budgets are outside of the PI-Managed Mission Cost.

Requirement S-10. Instrument Investigation proposals shall include integration plans and planning budgets that occur during Phase D, with the assumption that this phase will take two years. With the exception of the PI-Managed science, management, and engineering cost for Phase D identified in Table 1, these costs are outside the PI-Managed Mission Cost.

Requirement S-11. Instrument Investigation proposals shall include plans and planning budgets for the required costs to minimally support the project during a potential gap between instrument delivery (end of Phase C) and the start of integration with the spacecraft (start of Phase D). These budgets should be on a per-year basis for up to four years. These costs are outside the PI-Managed Mission Cost.

Table 1: List of portions of an Instrument Investigation cost that are within and outside the PI-Managed Mission Cost. Budgets for both are required in each proposal.

Portion of the Investigation	Within PI-Managed Mission Costs	Outside PI-Managed Mission Costs
Phase A	X	
Phase B	X	
Phase C	X	
Investigation Costs during a potential gap between completion of instrument and start of integration (planning budget up to four years, on a per-year basis)		X
Science Team activity within Phase D	X	
Key management and engineering staff during Phase D (Project manager, instrument manager, systems engineer, etc.) assuming a two year Phase D	X	
Integration and test to selected platform (within Phase D) (planning budget nominally two years)		X
Cal/Val planning (all phases)	X	
Postlaunch instrument commissioning activity (within Phase D)	X	
Phase E	X	
Phase F	X	
Cost for access to space		X
Education or Communication program, not required, see Section 4.6.		X
Student Collaboration (SC) (optional)	X – any SC cost above 1% of the PI-Managed Mission Cost	X - Up to 1% of the PI-Managed Mission Cost

4.4.1.2 *CubeSat Investigations Cost Requirements and Constraints*

For CubeSat Investigations, all costs are inside the PI-Managed Mission Cost except the cost associated with integration and launch of the CubeSats on the NASA selected launch vehicle(s), as identified in Table 2. The PI-Managed Mission Cost also includes the cost of the science team and of key management, mission, and engineering staff during the integration and test to selected launch vehicle part of Phase D, as this is not expected to be dependent on the launch services provided to the selected investigation. For support of the science team and key management and engineering during this part of Phase D, a one-year duration should be assumed for budgeting purposes.

Once an appropriate launch vehicle is determined (preferably before the Preliminary Design Review) minor changes to the CubeSat(s) may be required. Appropriate budget margin should be planned to account for such changes.

Costs that are outside the PI-Managed Mission Cost include integration to the NASA selected launch vehicle (part of Phase D); and investigation costs during any potential gap between the delivery of the completed CubeSat(s) (part of Phase D) and the start of integration to the designated launch vehicle (part of Phase D).

For planning purposes, the proposal must include estimates of cost for the part of Phase D (nominally one year) that would be outside the PI-Managed Mission Cost, as identified above. It is understood that final Phase D cost will be dependent on the selected launch service and the actual time frame for each development phase.

NASA also requires proposals to include plans and planning budgets that estimate the minimum costs for the project if there is a gap between the delivery of the completed CubeSat(s) (part of Phase D) and the start of integration of the CubeSat(s) to the designated launch vehicle (part of Phase D). CubeSat(s) and essential ground processing/algorithm/science development activities must not be planned during this gap as the CubeSat(s) must be completed for delivery; only maintenance activities, such as storage and periodic monitoring, must be planned. These “gap planning” budgets should be on a per-year basis up to a maximum of two years. The costs for both of these planning budgets are outside of the PI-Managed Mission Cost.

Requirement S-12. CubeSat Investigation proposals shall include launch vehicle integration plans and planning budgets that occur during this part of Phase D, with the assumption that this part of Phase D will take one year. With the exception of the PI-Managed science, management, and engineering cost necessary for this portion of Phase D identified in Table 2, these costs are outside the PI-Managed Mission Cost.

Requirement S-13. CubeSat Investigation proposals shall include plans and planning budgets for the required costs to minimally support the project and science during a potential gap between CubeSat(s) delivery (part of Phase D) and the start of integration with the launch vehicle (part of Phase D). These budgets should be on a per-year basis for up to two years. These costs are outside the PI-Managed Mission Cost.

Table 2: List of portions of a CubeSat Investigation cost that are within and outside the PI-Managed Mission Cost. Budgets for both are required in each proposal.

Portion of the Investigation	Within PI-Managed Mission Costs	Outside PI-Managed Mission Costs
Phase A	X	
Phase B	X	
Phase C	X	
Phase D (integration of instrument(s) to CubeSat(s) and delivery of CubeSat(s) to Launch Services)	X	
Investigation Costs during a potential gap between completion of CubeSat(s) and start of integration to launch vehicle (planning budget up to -two years, on a per-year basis)		X
Science Team activity within Phase D	X	
Key management and engineering staff during integration and test to selected launch vehicle part of Phase D (Project manager, instrument manager, systems engineer, etc.) assuming a one year part of Phase D	X	
Integration and test to selected launch vehicle (within Phase D) (planning budget nominally one year)		X
Cal/Val planning (all phases)	X	
Postlaunch instrument commissioning activity (within Phase D)	X	
Phase E	X	
Phase F	X	
Cost for access to space		X
Education or Communication program, not required, see Section 4.6.		X
Student Collaboration (SC) (optional)	X – any SC cost above 1% of the PI-Managed Mission Cost	X - Up to 1% of the PI-Managed Mission Cost

4.4.2 Full Cost Accounting for NASA Facilities and Personnel

This Section supersedes Section 5.5.5 of the SALMON-2 AO.

For the purpose of calculating the full cost of NASA-provided services, proposal budgets from NASA Centers, whether as the proposing organization or as a supporting organization, are to include, within the PI-Managed Mission Cost, all costs normally funded by an SMD Project under NASA's full cost accounting practices, including civil servant labor (salaries and benefits), civil service travel, and procurements. All of these costs must be clearly identified by year within the budget justification section of the proposal.

Estimated NASA Center Management and Operations (CM&O) overhead costs must also be included within the cost cap, to enable a level playing field for all proposers. Per Headquarters

policy guidance signed in June 2010 by the Associate Administrator, Mission Support Directorate and by the Agency Chief Financial Officer, all Centers shall use an identical CM&O burden rate of \$45K (FY 2017) per "equivalent head." For years after FY 2017, this number must be inflated. Per Agency policy, this rate must be applied as a "cost per equivalent head" to all Civil Service Full Time Equivalents (FTEs), plus on/near site contractor Work Year Equivalents (WYEs) associated with the proposal. The estimated FTEs and WYEs per fiscal year, and the resulting CM&O burden, must be identified in a separate table within the budget justification section of the proposal.

The CM&O burden costs must be clearly denoted in all budget tables. These costs may not be included or rolled into any other budget lines in such a way that they become unidentifiable.

Do not include within the cost proposal, or within the PI-Managed Mission Cost, any estimate for Agency Management and Operations (AM&O, a.k.a. NASA Headquarters overhead).

Table 3: Cost Elements for NASA Center Budget Proposals in response to SMD AOs

	Identify in proposal	Include in PI-Managed Mission Cost	Funding source	Comments
Civil Service Labor	Yes	Yes	SMD Program	Includes salaries and benefits
Civil Service Travel	Yes	Yes	SMD Program	
Other Direct/Procurements	Yes	Yes	SMD Program	Includes procurements as typically identified by flight projects in the NASA N2 budget database
CM&O	Yes	Yes	CASP	Applied to NASA provided labor, including Center civil servants and on/near-site contractors
AM&O	No	No	CASP	Includes NASA provided independent technical authority
NASA Contributed Costs	Yes	No	Identify	Must be non-SMD
Non-NASA Federal Government (funding requested from NASA)	Yes	Yes	SMD Program	If NASA funding is requested for the non-NASA Federal Government agency
Contributions	Yes	No	Identify	Includes all non-NASA contributions

Requirement S-14. Proposals including costs for NASA Centers shall conform to the full cost policy stated in this Section. Each of the elements of the NASA Center costs (direct labor, travel, and procurements) shall be separately identified by year.

If any NASA funded item(s) or services are to be considered as contributed costs, then the contributed item(s) must be separately funded by a non-SMD effort complementary to the proposed investigation, the value of the contribution(s) must be estimated, and the funding source(s) must be identified.

Requirement S-15. If any NASA funded item(s) or services are considered as contributed costs, then the proposal shall estimate the value of the contribution(s) and shall identify the funding source(s).

Any non-NASA Federal Government costs must follow the appropriate agency accounting standards for full cost. If no standards are in effect, the proposers must follow the *Managerial Cost Accounting Concepts and Standards for the Federal Government*, as recommended by the Federal Accounting Standards Advisory Board and available in the EVI-4 Library.

Requirement S-16. Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

4.4.3 Schedule Requirements and Constraints

Each selected Class C instrument investigation under this EVI solicitation will be expected to deliver an instrument that can be integrated onto a NASA-determined platform by August 31, 2022. Nominally, the selected investigation(s) development Phases A through C will span the years of FY 2017-FY 2022. Proposals that include a more rapid instrument development timelines may be selected, provided the required budget phasing can be accommodated by NASA.

Each selected Class D instrument or CubeSat investigation under this EVI solicitation will be expected to deliver an instrument that can be integrated onto a NASA-determined platform and/or a CubeSat(s) that can be integrated to a NASA-determined launch vehicle by August 31, 2021. Nominally, the selected investigation(s) development Phases A through C (or into Phase D for CubeSats) will span the years of FY 2017-FY 2021. Proposals that include more rapid development timelines may be selected, provided the required budget phasing can be accommodated by NASA.

It is expected that once an appropriate platform and/or launch service is determined by NASA, preferably before the Preliminary Design Review, minor changes to the selected instrument and/or CubeSat(s) will be required. Appropriate schedule margin should be planned to account for such changes.

Requirement S-17. For Class C instrument investigations, proposals shall include a development schedule that delivers an instrument for integration onto the selected platform no later than August 31, 2022. For Class D instrument or CubeSat investigations, proposals shall include a development schedule that delivers an instrument for integration onto the selected platform and/or a CubeSat(s) that can be integrated to a launch vehicle no later than August 31, 2021.

4.5 Technical Requirements and Constraints

4.5.1 *New Technologies/Advanced Engineering Developments*

This section intends to clarify the requirement for New Technologies and/or Advanced Engineering Developments and supersedes Section 5.3.4 of the SALMON-2 AO.

This EVI-4 PEA solicits flight missions, not technology or advanced engineering development projects. Proposed investigations are generally expected to have mature technologies, with systems at a Technology Readiness Level (TRL) of 6 or higher. For the purpose of TRL assessment, systems are defined as level 3 Work Breakdown Structure (WBS) payload developments (i.e., individual instruments) and level 3 WBS spacecraft elements (e.g., electrical power system); see Figure 3-7 of the *NASA WBS Handbook*, NASA/SP-2010-3404, which can be found in the EVI-4 Library. TRLs are defined in NPR 7123.1B *NASA Systems Engineering Processes and Requirements*, Appendix E, which can be found in the EVI-4 Library.

Proposals with a limited number of less mature technologies and/or advanced engineering developments are permitted as long as they contain a plan for maturing systems to TRL 6 (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*) by no later than at Preliminary Design Review (PDR) and adequate backup plans that will provide mitigation in the event that the systems cannot be matured as planned. The TRL state of systems may be validated by an independent team at PDR.

Requirement S-18. Proposals that use systems currently at less than TRL 6 shall include a plan for system maturation to TRL 6 by no later than PDR and a backup plan in the event that the proposed systems cannot be matured as planned (see Section 5.1 of this PEA, for additional detail).

4.5.2 *Instrument Investigation Science Instrument System and Platform Interfaces*

Because there is no defined platform that directly limits the design of the proposed instrument characteristics and observing strategy, this PEA does not list specific requirements or constraints for mass, instrument dimensions, power consumption, data rate, platform stabilization, observational geometry, launch vibration, or desired orbit. However, all of these characteristics must be well characterized and clearly stated within the proposal in order for NASA to determine the feasibility of finding an appropriate platform in the near future to deploy any potential selected instrument.

Instruments that have less stringent and more easily accommodated requirements will be considered more desirable for selection, providing they return high value science, as they are more flexible in being accommodated by the range of potential platforms available in the near future.

Requirement S-19. Proposals for instrument investigations that will be accommodated on a NASA selected platform shall clearly state the proposed instrument mass, volume dimensions, power requirements, platform stabilization requirements, thermal requirements, observational geometry requirements, launch vibration constraints, electromagnetic interference/electromagnetic compatibility (EMI/EMC) requirements, data rate requirements,

and all other requirements (or constraints, preferences, etc.) that the instrument places on the platform for accommodation, launch, deployment, operations, etc. A template is provided on the EVI-4 Library to aid proposers to provide this data. This table shall be provided in the experiment implementation section (Section E) of the proposal. This table does not count towards the proposal page limit.

NASA has been cataloguing the potential platforms that will exist over the next decade with capacity to accommodate a potential EVI Instrument. The goal of this activity is to document, as a service to both NASA and all who are interested in potential integration of instruments on available payloads, the types of opportunities that exist and the current interfaces and constraints that exist for each potential platform. It is also desired that, as much as possible, agreements can be reached as to potential common instrument interfaces for many of these potential platforms. Documentation of this Common Instrument Interface (CII) work is available through links in the EVI-4 Library.

One result of this work is to determine the relative probabilities of NASA identifying a feasible opportunity platform for any potential or proposed EVI instrument. A proposed instrument with a high probability of being compatible with several potential platforms is more likely to be selected than an instrument with less flexible accommodation and orbit requirements (see Section 6.2).

Compared with other candidate platforms, the International Space Station (ISS) may be able to accommodate instruments with higher requirements for mass, volume/dimensions, power, and thermal control. Proposers should state whether the ISS is a potential platform for their instrument and identify the tradeoffs of using the ISS orbit vs. other orbits. Proposers that identify ISS as a potential platform must maintain flexibility to be accommodated on other platforms. Even though NASA has current plans to support ISS operations through 2024, any instrument investigation that is appropriate for the ISS should describe an adequate timeline of development and operation for the proposed investigation, regardless of whether it is completed by the end of 2024. Differences between the investigation's timeline and NASA's plans for future ISS operations will be factored into the proposal's risk assessment for selection.

Proposals may include information on any research the proposing team has done relative to potential payload accommodations for their proposed instrument. This is not a requirement for any proposal. However, such information can serve to demonstrate to NASA the potential of finding one or more opportunities for accommodating the proposed instrument. If a proposal includes such information, effort should be made to address all known integration criteria and make clear which integration criteria have not been completely researched. Failure to include such research will not be counted against a proposal in evaluation. Inclusion of such information has the potential to support the arguments within a proposal that the instrument has an acceptable chance of being integrated on a platform within an appropriate time frame.

4.5.3 *CubeSat Investigations*

CubeSat proposals are recommended to comply with the Cal Poly CubeSat Design Specification, found at <http://www.cubesat.org/resources/>. NASA's Launch Services Program has issued a *Program Level Dispenser and CubeSat Requirements Document* (found in the EVI-4 Library)

with standard requirements for launching CubeSats with form factors up to 6U and qualifying form factors of 1U, 1.5U, 2U, 3U and 6U.

Concepts that do not comply with these standards should clearly describe how their designs are packaged and deployed, but with the understanding that CubeSat form factors larger than 6U will not be considered.

Requirement S-20. All CubeSat investigations proposing compliance with the requirements in the NASA Launch Services Program *Program Level Dispenser and CubeSat Requirements Document* shall propose CubeSat form factors (size) no larger than 6U, with qualifying form factors of 1U, 1.5U, 2U, 3U and 6U. Concepts that do not comply with these standards should clearly describe how their designs are packaged and deployed. CubeSat form factors larger than 6U will not be considered.

4.5.4 Orbit Requirements

Requirement S-21. Proposals shall clearly state the desired and acceptable orbits and operational constraints (e.g., duty cycle or observational cadence) and describe the relative scientific merits of each possible orbit.

4.5.5 Payload Risk Classification

This opportunity solicits proposals for science investigations requiring the development and operation of space-based instrument(s) of either Class C or Class D risk classification (as defined in NPR 8705.4, *Risk Classification for NASA Payloads*; found in the EVI-4 Library). CubeSats are designated as Class D. Section 4.4.1 describes the Cost Caps for Class C vs. Class D investigations.

Requirement S-22. If an investigation requires operation on-orbit for two or more years to meet the science requirements, the proposal must demonstrate how the instrument will meet that time requirement. If any requirements to the instrument that are more stringent than Class C (or Class D, as appropriate for each proposal) are needed, these requirements must be clearly described in the proposal.

4.5.6 End-of Mission Spacecraft Disposal

Section 5.3.10 of the SALMON-2 AO discusses the requirements related to end-of-mission spacecraft disposal for Partner Missions of Opportunity and hosted payloads where the PI is not responsible for the host mission. For instrument investigation proposals, information shall be included regarding the instrument's plan for passivation at the end of operations or in preparation for end-of-mission disposal. In addition, information shall be provided identifying system components expected to survive Earth reentry as the postmission disposal method. This will allow NASA to remain in compliance with NPR 8715.6A, *NASA Procedural Requirements for Limiting Orbital Debris*, and NASA-STD-8719.14, *Process for Limiting Orbital Debris*.

Requirement S-23. Instrument investigation proposals shall describe the instrument's passivation plans at end-of-mission and identify components anticipated to survive Earth reentry.

This supersedes Requirement 39 in the SALMON-2 AO for instrument investigation proposals. However, Requirement 39 shall be met for CubeSat proposals.

4.5.7 NASA Earth Science Data Policy

4.5.7.1 Data Analysis

The PI will be responsible for production and analysis of the mission data necessary to achieve the proposed science objectives, delivery of products to NASA selected Distributed Active Archive Centers (DAAC), and for timely publication of initial scientific results in refereed scientific journals, as part of their mission operations (Phase E) or postmission activities. The assigned NASA DAAC(s) will be responsible for archival and public distribution of all data collected by the instrument(s) and produced by the investigations prime measurement phase. The PI is required to work with the DAAC to ensure that the mission data is delivered in a format that meets NASA requirements. The NASA DAAC will not levy any additional cost for its services to the PI, therefore this cost is not to be included as part of the PI Managed Mission Cost. Science studies with the archived data sets beyond the science investigations proposed by the PI-led team will be solicited and selected by NASA in subsequent NASA solicitations through the Research Opportunities in Space and Earth Sciences (ROSES) NASA Research Announcement (NRA).

Requirement S-24. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final on-orbit calibration and validation of the measurements. Proposal shall show adequate resources for delivering data products to the assigned NASA DAAC.

Requirement S-25. Proposals shall clearly present a plan for analysis of the mission data leading to completion of the proposed science investigation and achieving the identified investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.5.7.2 Data Rights

By NASA policy, all science data returned from NASA missions are made available immediately in the public domain. There shall be no period of exclusive access. The principal investigator shall propose and justify the data product latency period for standard products listed in the proposal, based primarily on the time required to produce, quality-check, and validate the products. Barring exceptional circumstances, data product latency may not exceed six months.

Requirement S-26. Proposals shall include a clear commitment to minimizing the latency for data products. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.5.7.3 Delivery of Data to Archive

Mission data will be made fully available to the public in the minimum time necessary, and no longer than six months following its collection, barring exceptional circumstances. The PI will

be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data. During Phase A, NASA will assign a data center, e.g., one of the Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAACs), to be the data archive. Proposals should not be tailored to one specific DAAC. Throughout the investigation, the project will deliver all data products, along with the scientific algorithm software, coefficients, and ancillary data used to generate these products, and the algorithm and calibration documentation to the NASA-assigned DAAC as they are generated or updated. Information on EOSDIS and the DAACs is available at <https://earthdata.nasa.gov/about/esdis-project> and <https://earthdata.nasa.gov/about/daacs>.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in-flight), documentation, related software, and/or other tools or parameters that are necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of NASA Earth Science data archives. For information on NASA Earth Science data policy, nomenclature, standards, and EOSDIS, see <http://science.nasa.gov/earth-science/earth-science-data/>. Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the capped PI-Managed Mission Cost.

Requirement S-27. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, metadata generation and delivery to the assigned NASA DAAC for public distribution, and archiving shall be described. The science products (*e.g.*, flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the formats and standards to be used, selected from the published list of approved NASA Earth Science Data System Standards (<https://earthdata.nasa.gov/data/standards-and-references>). It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community. The plan shall conform to the NASA Earth Science Data and Information Policy (see <http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/>). This supersedes Requirement B-21 in Appendix B of the SALMON-2 AO.

4.6 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are specified in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.4.1.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirement and constraints for that specific solicitation, including the sponsoring NASA Headquarters mission directorate and division, the type of MO, the cost cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2, the cost cap is specified in Section 4.4.1, and the schedule constraint is specified in Section 4.4.2.
- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. The NASA Center for program office is specified in Section 2.3.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the payload risk classifications are specified in Section 4.5.5.
- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation in this solicitation. For this PEA, those limitations are specified in Section 4.1
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Mission Cost, the Total Mission Cost, and the Enhanced Mission Cost. For this PEA, that information is specified in Sections 4.4.1 and 4.4.2.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.4.1, 4.4.2 and 4.4.3.
- Section 4.6 of the SALMON-2 AO states that each PEA will identify any NASA-provided launch services. For this PEA, NASA plans for access to space are discussed in Section 2.2, 4.5.2 and 4.5.3.
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Section 3 that evaluation and selection will be done using a single step selection process; no competitive Phase A (Step 2) or down selection is planned.
- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an Education or Communication (previous E/PO) program that is consistent with SMD policy is required. This PEA states that an Education program is not required. A Communication program may be required, pending further NASA guidance for Communication policy, and those costs will

be outside the PI-Managed Mission Cost cap. Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA.

- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by NASA SMD and it does not permit contributions of funding from SMD programs other than the funding offered through this PEA.
- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection Official. This PEA identifies the Selection Official in Section 6.2.

4.7 Exceptions to General SALMON-2 Requirements

This PEA contains the following exceptions to the SALMON-2 proposal preparation and submission requirements described in the SALMON-2 AO.

- Proposals or portions of proposals requesting NASA funding shall report proposal costs in Fiscal Year 2020 dollars as well in Real Year (RY) dollars. The former is for determining compliance with the PI-Managed Mission Cost cap requirement. The latter is for NASA SMD budget planning. This instruction supersedes the request for costs only in RY dollars described in Appendix B of the SALMON-2 AO including Table B-3. A modified template of Table B-3 is available on the EVI-4 library.
- Requirement ~~ST~~-19 in Section 4.5.2 of this PEA requires the inclusion of a table in the proposal document. As noted in the requirement, this table does not count against the page limits specified in Appendix B of the SALMON-2 AO. **[Requirement letter corrected August 16, 2016]**
- Section 4.5.7 of this PEA provides data policies and supersedes Section 4.4 of the SALMON-2 AO.
- Proposals shall not include a plan or a budget for science-exploration-technology enhancement options (SEOs); this supersedes Section 5.2.5 of the SALMON-2 AO.
- Section 4.5.6 provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO.
- The proposal's Heritage Appendix will be limited to 30 pages. This supersedes the proposal's Heritage Appendix (proposal Appendix J.9) page limit as stated on the "Proposal Structure and Page Limits" table in page B-2 of the SALMON-2 AO. Also, note that cost information in the heritage appendix is limited to a comparison of the cost of the heritage items to the proposed items' cost. Cost information for the proposed investigation is only permitted in Section H.
- Section 5.1 provides Proposal Content Requirements; in this section Requirement ~~ST~~-30 supersedes Requirement B-15 of the SALMON-2 AO, Requirement ~~ST~~-31 supersedes Requirement B-23 of the SALMON-2 AO, Requirement ~~ST~~-32 supersedes Requirement B-24 of the SALMON-2 AO, Requirement ~~ST~~-33 supersedes Requirement B-27 of the SALMON-2 AO and Requirement ~~ST~~-34 supersedes Requirement B-57 of the SALMON-2 AO. **[Requirement letters corrected August 16, 2016]**

5 PROPOSAL PREPARATION AND SUBMISSION

5.1 Proposal Content Requirements

Requirement S-28. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO.

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA reviewers.

The key data associated with the electronic submission of proposals (see Section 6.2 of the SALMON-2 AO) includes questions indicating whether or not a proposal contains export-controlled information (see Sections 5.9.4 and 5.10.2 of the SALMON-2 AO). All proposers must answer these questions YES or NO when completing the electronic submission; these questions shall not be left unanswered.

All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO. To the extent possible, International Traffic in Arms Regulation (ITAR) sensitive material should be organized into separate clearly marked sections.

Requirement S-29. All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO.

Below, Requirements B-15, B-23, B-24, B-27 and B-57 of Appendix B of the SALMON-2 AO are clarified for this solicitation. All references to "instruments" in this section also apply to CubeSats.

The following Requirement ~~S~~-30 further clarifies the information requested on the traceability of the proposed investigation and supersedes Requirement B-15 of the SALMON-2 AO. A modified template is available on the EVI-4 Library to assist proposers on presentation of the investigation traceability. **[Requirement letter corrected August 16, 2016]**

Requirement S-30. Traceability from science goals to measurement requirements to instrument requirements (functional and performance) and to top-level mission requirements shall be provided in tabular form and supported by narrative discussion. Instrument projected performance shall be compared to the instrument (or CubeSat) performance requirements.

The following Requirement ~~S~~-31 clarifies the information requested on instrument contingencies and margins and supersedes Requirement B-23 of the SALMON-2 AO. **[Requirement letter corrected August 16, 2016]**

Requirement S-31. This section shall summarize contingencies and margins of all instrument resources. It shall provide estimates of implementation design margins with respect to the required performance or allocations for mass, power, data storage, and any other resource requirements. For proposals for more than one instrument, the mass, telemetry, and power and

contingency and margins must be identified separately for all the necessary components of each instrument in case only an individual instrument is selected from the proposed suite (see SALMON-2 AO for definitions of contingency and margin). Discuss the allocation of contingency and margin to the instrument and/or suite.

The following Requirement ~~ST~~-32 clarifies the information requested on performance margins and supersedes Requirement B-24 of the SALMON-2 AO. [**Requirement letter corrected August 16, 2016**]

Requirement S-32. For each instrument performance, this section shall provide estimates of performance margin with respect to the performance requirements as compared to projected performance estimates and shall justify that these performance margins are appropriate.

The following Requirement ~~ST~~-33 clarifies the information requested on new technologies and/or advanced engineering developments and supersedes Requirement B-27 of the SALMON-2 AO. [**Requirement letter corrected August 16, 2016**]

Requirement S-33. This section shall describe any proposed new technologies and/or advanced engineering developments and the approaches that will be taken to reduce associated risks. Descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed system (level 3 WBS payload developments and level 3 WBS spacecraft elements) incorporating new technology and/or advanced engineering development at the time the proposal is submitted (for *TRL definitions*, see NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*, Appendix E, in the EVI-4 Library);
- Rationale for combining the TRL values of components and subsystems to derive each full system TRL as proposed, appropriately considering TRL states of integration (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*);
- Rationale for the stated TRL value of an element that is an adaptation of an existing element of known TRL;
- The approach for maturing each of the proposed systems to a minimum of TRL 6 by PDR:
 - Demonstration (testing) in a relevant environment can be accomplished at the system level or at lower level(s);
 - If applicable, justify what demonstration(s) in a relevant environment at lower level(s) (subsystem and/or subsystem-to-subsystem) would be sufficient to meet system level TRL 6, considering (i) where any new technology is to be inserted, (ii) the magnitude of engineering development to integrate elements, (iii) any inherent interdependencies between elements (e.g., critical alignments), and/or (iv) the complexity of interfaces – see the EVI-4 Library for examples;
 - Include discussion of simulations, prototyping, demonstration in a relevant environment, life testing, etc., as appropriate;
- An estimate of the resources (staffing, cost, and schedule) required to complete the technology and/or advanced engineering development; and
- Approaches to fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance

liens they impose on the baseline design, and the decision milestones for their implementation.

If no new technologies or advanced engineering development is required, system TRL 6 or above at the time of proposal submission shall be clearly demonstrated.

Requirement ~~ST~~-34 clarifies the intent of Requirement 89 and B-57 of the SALMON-2 AO. Requirement ~~ST~~-34 supersedes Requirement B-57 of the SALMON-2 AO. [**Requirement letter corrected August 16, 2016**]

Requirement S-34. The following additional information is required to be supplied with the proposal as Appendices and, as such, will not be counted within the specified page limit. The proposer shall not include in these Appendices material required in the page-limited sections in the body of the proposal. Any additional information not specifically required in a given appendix will not be considered by the evaluation panel and may result in reduced ratings during the evaluation process or, in some cases, could lead to rejection of the proposal without review. No other appendices are permitted.

5.2 Proposal Submission Requirements

Requirement S-35. Proposals must be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only.

Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement S-36. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

The proposal evaluation process requires evaluators free of Conflict of Interest. In order to assist NASA in the planning of the proposal evaluation process, NASA requires a comprehensive list of proposed investigation participants.

Requirement S-37. With the proposal submission via NSPIRES, the proposers shall identify any institution that is specified in the proposal but that does not appear in either the "Team Member" section (Section VI) of the cover page or in answer to the question about "participants [...] who do not appear on the proposal's cover page". The proposer shall list the institution and division name, role (e.g., instrument component provider), and estimated funds to be received. This information will be used to avoid financial and organizational conflicts of interest during the evaluation process by checking evaluators against institutions that are proposed to supply materials, parts, or services.

5.3 Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this appendix, or in the documents available through the EVI-4 Library,

should be sent to the E-mail address for the point of contact that is listed in Section 7 of this PEA. When appropriate, responses will be posted on the website also listed in Section 7 of this PEA.

The deadline for receipt of questions is two weeks before the proposal due date listed in Section 7 of this PEA.

6 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

In addition to the evaluation criteria given in Section 7.2 of the SALMON-2 AO, the evaluation of the Science Merit of the Proposed Investigation also includes the following addition to Factor A-2:

- Factor A-2, programmatic value of the proposed investigation, also includes the extent to which the proposed science investigation addresses unique science areas that are not being addressed by other missions (both NASA and non-NASA missions) expected to be in operation five to ten years from the start of the proposed investigation.

In addition to the evaluation criteria given in Section 7.2 of the SALMON-2 AO, the evaluation of the Experiment Science Implementation Merit and Feasibility of the Investigation also includes the following additions to Factors B-2 and B-3:

- Factor B-2, probability of technical success, also includes the maturity of the design or the demonstration of a clear path to achieve the necessary maturity.
- Factor B-3, merit of the data and/or sample analysis plan, also includes the quality of the plans for calibration and data archiving, including development of a data pipeline.

The panel evaluating the third evaluation criterion; Technical, Management, and Cost (TMC) Feasibility of the Investigation Implementation, including Cost Risk, will also provide comments to NASA regarding the extent to which the proposed instrument is compatible with potential satellite platform interfaces and operations or the CubeSat mission is compatible to potential launch opportunities. These comments will not be considered for the TMC Feasibility of the Investigation Implementation, including Cost Risk evaluation.

After the evaluation, but prior to the selection decision, NASA will perform an accommodation study of selectable instrument investigation proposals to assess the extent to which the proposed instrument is compatible with potential satellite platform interfaces and operations. This accommodation study will also consider the accommodations of selectable CubeSat proposals for launch.

6.2 Selection Process

After the review by the AO Steering Committee, the final evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the selection(s). As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency, including the Director of the Earth Science Division, concerning the selections.

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among selectable proposals, including, but not limited to, planning and policy considerations, available funding and funding profiles, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the Mission Directorate(s). For an EVI Instrument proposal selection, these factors also include the likelihood that the proposed instrument can be accommodated on a NASA-selected platform in the near future. For an EVI CubeSat proposal selection, these factors also include the likelihood that the appropriate launch services can be provided.

6.3 Implementation Activities

Proposal award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO and this section of this PEA with the following amendments.

6.3.1 Award Administration and Funding of Investigations

Oversight management responsibilities have been assigned to the Earth System Science Pathfinder Program Office (ESSP PO) at the NASA Langley Research Center (LaRC). The responsibilities of the ESSP PO will include oversight of the selected investigation(s) development; coordination of Government-furnished services, equipment and facilities, coordination of the selected team with potential platforms for integration; and contract management for selected investigations.

The ESSP PO will authorize the release of funding to each selected investigation. The initiation of the investigation will take place as soon as possible after notification of selection.

Investigators are advised that Statements of Work (SOWs), updated cost, and pricing data are required to initiate awards. For reference, a SOW template is available in the EVI-4 Library. If more than one contractual arrangement between NASA and the proposing team is required, separate SOWs, updated cost, and pricing data are required for each contractual arrangement. NASA Centers will receive funding via intra-agency funding mechanisms.

Proposals are not required to include SOWs and cost and pricing data. However, these items will be required for investigations selected for award. The process of awarding contracts cannot begin until final SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed. For each selection, and unless otherwise stated in the selection letter, the selected investigation's Cost Cap will be set at the proposal's proposed cost.

SOWs will be required for selected investigations, regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). For contracts that exceed \$750K, the contractor will be required to provide cost and pricing data to support the cost estimate and to certify the cost proposed for the contract in accordance with FAR 15.403-4.

NASA Centers shall follow their standard operation procedure for selecting teaming partners to facilitate the rapid implementation of their proposal, if selected, and this shall be documented in Appendix 6 of the proposal (see Appendix B, Section J.6, of the SALMON-2 AO).

6.3.2 *International Agreements*

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, NASA's Office of International and Interagency Relations, Science Division, will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency Memorandum of Understanding (MOU). For additional policies and requirements, see Section 5.9 of the SALMON-2 AO.

7 SUMMARY OF KEY INFORMATION

Funding available	See Section 4.4.1 of this PEA
PEA Release Date	July 27, 2016
Date for Pre-proposal Teleconference/WebEx	August 18, 2016 via Webex; see the EVI-4 Acquisition Homepage at http://essp.larc.nasa.gov/EVI-4/ for time, agenda, and logistical information
Due Date for NOI (notice of intent to propose, required for this solicitation)	11:59 pm eastern time on September 1, 2016
Last Date for submission of Questions	11:59 pm eastern time on November 4, 2016
Due Date for Proposals	11:59 pm eastern time on November 18, 2016
EVI-4 Acquisition Homepage (for additional information on the EVI-4 PEA)	http://essp.larc.nasa.gov/EVI-4/
Library for the EVI-4 PEA	http://essp.larc.nasa.gov/EVI-4/evi-4_library.html
Submission Medium	Electronic copies only; see Section 5.2 of this PEA
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)

NASA point of contact	Dr. Thomas Wagner Earth Venture Instrument-4 Program Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-4682 E-mail: thomas.wagner@nasa.gov
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END OF PEA S

**NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF
OPPORTUNITY NOTICE (SALMON-2)**

**NNH12ZDA0060-KPLO
ELEMENT APPENDIX (PEA) T:
HOSTED PAYLOADS ON KOREA
PATHFINDER LUNAR ORBITER (KPLO)**

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NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF
OPPORTUNITY NOTICE (SALMON-2)

NNH12ZDA0060-KPLO
ELEMENT APPENDIX (PEA) T:
HOSTED PAYLOADS ON KOREA
PATHFINDER LUNAR ORBITER (KPLO)

1 BACKGROUND

1.1 Programmatic Overview

The National Aeronautics and Space Administration (NASA) issues this Second Stand Alone Missions of Opportunity Notice (SALMON-2) Program Element Appendix (PEA) for the purpose of soliciting proposals for Ride Share Payloads on the Korea Pathfinder Lunar Orbiter (KPLO).

Supported by their National Policy plan, #13, the Republic of South Korea, through the Korea Aerospace Research Institute (KARI), has created a goal to robotically explore the moon and has established a lunar program called Korea Lunar Exploration Program (KLEP). KARI intends on launching KPLO followed by a lunar lander including a lunar surface rover, and another orbiter by 2020. The first mission would be the launch of the KPLO in December, 2018 on a technology demonstration and science mission into lunar orbit. KARI is in partnership with NASA to provide ride share for NASA sponsored payloads on the KPLO mission. Proposals should address scientific investigations that advance the objectives outlined in Section 2 of this PEA.

This solicitation calls for proposals for complete Principal Investigator led (PI-led) science investigations requiring spaceflight instrument development. This opportunity solicits flight instruments that do not require significant technology development. The term “complete” encompasses investigation phases from project initiation, through instrument development and science operations, to scientific analysis of space-based data. When deployed on the KPLO mission, these spaceflight instruments will be used to conduct innovative, integrated, hypothesis- or question-driven investigations addressing the Strategic Knowledge Gaps (SKGs) associated with Lunar Volatiles described in Sections 1.2, 2.1, and 2.2.

Proposed investigations will be evaluated and selected through a two-step competitive process (Section 6). The total budget allocation for NASA-funded instruments through Phase D not including integration costs is \$15,000,000. NASA will establish a budget allocation for Phase E and F based on instrument selection, but anticipates that budget will be not more than \$3,000,000. NASA intends to make up to 4 awards totaling up to this amount. Priority will be given to cost-effective instruments with significant science return, manageable cost risk, and demonstrated understanding of the challenges presented by the operational environment and associated mitigation plans for addressing those challenges.

KARI is developing the final scope and architecture for this mission. While this PEA describes plans and dates, proposers should be aware that these plans will adjust to programmatic decisions

(e.g., mission architecture) made by KARI and NASA in the near future. In particular, at any time NASA may choose, without consultation with proposers, to accelerate or decelerate the schedule by altering the evaluation and selection process. The evaluation criteria will remain as detailed in this document regardless of schedule alterations.

1.2 Strategic Knowledge Gaps for Lunar Exploration

Strategic Knowledge Gaps (or SKGs), represent gaps in knowledge or information required to reduce risk, increase effectiveness, and improve the design of robotic and human space exploration missions. NASA uses SKGs to help inform research and investment strategies, define mission objectives and prioritize technology development.

The Moon still has many unknowns, especially related to the form, abundance, accessibility and economic viability of resources that can be used for the purposes of In-Situ Resource Utilization (ISRU). The first step in exploration for ISRU is to find the resources and characterize them. The characterization of these resources will also be of benefit to the scientific knowledge base of the Moon. The highest priority topics have been identified in the NASA lunar SKGs which serve as guidance for proposed payloads that should be flown to the lunar environment.

Several lunar orbiter missions such as the Lunar Prospector, Clementine, Chandrayaan-1, and Lunar Reconnaissance Orbiter have discovered various signatures of water and hydroxide, the orbits of those missions along with the on-board analytical capabilities obtained significant but not completely conclusive science data to fully discern the various forms of water (ice, vapor, and liquid) or other volatiles.

Data from NASA's Lunar CRater Observation and Sensing Satellite (LCROSS), and Lunar Reconnaissance Orbiter (LRO) missions indicate that as much as 6% of the material kicked up by the LCROSS impact were volatiles, including water, methane, ammonia, hydrogen gas, carbon dioxide and carbon monoxide. The instruments also discovered relatively large amounts of light metals such as sodium, mercury and possibly even silver.

The focus of this solicitation is to provide better understanding of the lunar resources. Utilizing these resources found naturally in extraterrestrial soils, or leveraging ISRU technologies will foster increased understanding in the planning to develop more affordable and sustainable human exploration to many deep-space destinations. Humans living, working and exploring other planetary bodies must be able to make their own breathable air and potable water for sustainable long-term missions and increased independence from logistics missions as well as laying the groundwork for permanent presence. We know that some of the basic ISRU components exist on the moon. Hydrogen and oxygen can be used to make these vital consumables, but those same elements also comprise the most vital building blocks of rocket propellants as well.

1.3 Overview of this Program Element Appendix

NASA issues this Program Element Appendix (PEA) as an Appendix of the Second Stand Alone Missions of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO) for the purpose of soliciting proposals for Mission of Opportunity (MO) investigations to be implemented through the Advanced Exploration Systems (AES) Division of the Human Exploration and Operations Mission Directorate (HEOMD). All investigations proposed in response to this solicitation must support the goals and objectives stated in Section 2.1 and

Section 2.2. All proposed investigations must be implemented by PI-led investigation teams (Section 5.4 of the SALMON-2 AO).

Instrument investigations must provide a flight qualified spaceflight instrument or instrument package ready for integration on the KPLO mission (Phase A-C) and the technical support for integration onto the KPLO mission (Phase D, see Section 4.4.1). The on-orbit operations and the delivery of science quality data (Phase E), as described in Section 4.1 of the SALMON-2 AO should be proposed and budgeted for in the proposal but will be funded by out-year NASA budgets.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO contains additional requirements on the format and content of the proposals. Documents available in the KPLO Program Library provided alongside the Appendix at <https://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={AF44B73B-7DBF-5540-1793-4C5491CFFE7C}&path=init> are intended to provide guidance for investigations selected; they are specifically not intended to impose requirements on proposals.

1.4 NASA On-line Document Information System

NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents are available through the NASA On-line Document Information System (NODIS) at <http://nodis3.gsfc.nasa.gov/>.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 Advanced Exploration Systems (AES)

NASA's AES division is pioneering innovative approaches and public-private partnerships to rapidly develop prototype systems, advance key capabilities, incorporate science integration and validate operational concepts for future human missions beyond Earth orbit.

AES activities are related to long term spaceflight architecture designs, crew mobility, habitation, vehicle systems, robotic precursors, international partnerships and foundational systems for deep space. These activities are strongly coupled with future vehicle development while advancing critical competencies at the NASA centers. AES infuses new technologies developed by the [Space Technology Mission Directorate](#) and partners with the Science Mission Directorate to address [Strategic Knowledge Gaps](#) for multiple destinations.

AES is focused on early integration and testing of prototype systems that will reduce risk, increase science understanding to improve affordability of deep-space missions. The prototype systems developed in the AES are demonstrated in ground-based test beds, field tests, underwater tests, flight experiments on the International Space Station (ISS), cislunar missions, and deep-space missions.

2.2 Goals and Objectives of the Hosted Payloads on the KPLO mission.

The KPLO mission objectives are to demonstrate technologies necessary for lunar and space

exploration. The KPLO mission will perform lunar science with high resolution images of the lunar surface, evaluating the geology and lunar resources as well as investigating the space environment near and/or on the surface of the moon. In addition, technology demonstrations include proving Disruption Tolerant Network (DTN) methodologies.

KARI has selected a four instrument suite as part of their primary mission along with the DTN technology demonstration. The instruments and their measurement goals are as follows:

1. LUnar Terrain Imager (LUTI) – high resolution camera
 - < 5m resolution images of selected regions on the lunar surface
 - Single bandpass filter covering 450nm to 850 nm
 - Stereo imaging capability (by acquiring image pairs at different viewing geometries)
 - Topographical measurements intended to inform robotic landing sites selection for future KARI missions
2. Polarimetric Camera (PoICam)
 - Polarimetric map of near and far side surfaces (using wavelengths of 320nm, 430nm and 650 nm)
 - 70m spatial resolution
 - Characterization of lunar regolith and space-weathering processes
3. KPLO Gamma Ray Spectrometer (KGRS)
 - Mapping of major elements (Mg, Ni, Cr, Ca, Al, Ti, Fe, Si, O, U, He-3) and water
4. KPLO Magnetometer (KMAG)
 - Provides 3D map of lunar magnetism, and additional magnetic science of lunar swirls
 - Origin of crustal magnetism in Earth-Moon system

2.2.1 Focus of NASA Solicited Instruments

The instruments solicited by AES for this mission should not duplicate the measurements obtained by the KARI instruments. AES specifically solicits proposals that address the following SKGs:

- Spatial and temporal distribution of OH and H₂O at high-latitudes
- Detect and measure exospheric water in association with surface-correlated deposits
- Monitor and model movement of volatiles towards and retention in Permanently Shadowed Regions (PSRs)
- Geomorphology, accessibility, and geotechnical characteristics of cold traps

Although fully retiring all these SKGs may require landed missions, these SKGs can be partially addressed through additional observations and data analysis from orbital missions. The KPLO mission with its intended orbit profile (100 km circular, polar orbit) and duration (approximately one year) has the potential to get data over an increased surface coverage and repeated observations over eleven months. Another important advantage of a mission with a circular orbit is the ability to obtain data with a consistent viewing geometry and entire surface coverage of the Moon with similar spatial resolutions.

2.3 Accommodation of KPLO Instruments

The objective of this solicitation is to select Instrument Investigations where instruments are built and deployed on the KPLO mission followed by production of high quality and highly useful exploration/science data from that instrumentation to address one or more SKGs

described in Section 2.2. Instrument investigations will be proposed without a firm identification of the spacecraft interfaces to accommodate these instruments. Therefore, selection of proposals from this solicitation will take into account the ability to accommodate the proposed instruments, as well as the value of the data to be returned from the selected investigations.

Since the KPLO mission architecture and spacecraft are still in the definition phase, the available payload resources, including size, mass, power, thermal control, pointing stability, pointing ability, orbits, and data rates, are provided as a guidance at this time. Section 4.5.2 lists critical parameters and current available resource estimates within which the payloads must operate. This information reflects NASA's best understanding of mission concepts that are judged to be both compelling and feasible. However, the final mission architecture and its associated payload parameters and resources are not yet determined. Proposed instruments that cannot meet many of the requirements anticipated for likely mission architectures will be seen as a higher risk for accommodation than those that have higher specification margins.

2.4 NASA Management of KPLO Investigations

The Advanced Exploration Systems Division in the Human Exploration and Operations Mission Directorate will manage the selected investigation(s). The AES Division Director may subsequently reassign the KPLO investigation to a NASA Center for project oversight. If reassigned, the responsible center will be required to have appropriate protective firewalls between the Project Managers for the KPLO payloads and the rest of NASA Center since this PEA allows investigators from the NASA Center to propose. The center project management team will then manage the KPLO instrument investigations under the tailorable requirements of NPR 7120.5E, NASA Space Flight Program and Project Management Requirements, as described in Section 4.1.2 of the SALMON-2 AO.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

This solicitation is an appendix to the NASA SALMON-2 AO. The SALMON-2 AO provides the overall structure and guidelines for several types of mission of opportunity solicitations. Each new opportunity is announced with a Program Element Appendix (PEA). This document is such a PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com> and at <http://go.nasa.gov/SALMON2-AO>.

This PEA solicits planetary science investigations that include the development of instruments to be provided to and integrated with the KARI KPLO spacecraft and integrated with a yet-to-be-identified launch vehicle.

Critical parameters and resource estimates are from the KPLO Systems Requirements Review (SRR) in July 2016. It is expected that the Systems Definition Review (SDR) in December 2016 will update the parameters and estimates.

The following schedule applies to this PEA:

PEA Release Date.....September 13, 2016

Mandatory Notice of Intent (NOI) deadline	September 30, 2016
Proposal Submittal Deadline	November 18, 2016
Step-1 Selections Announced (target)	January 16, 2017
Instrument Delivery Date for Integration	Launch-12 months

Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA.

A Notice of Intent (NOI) to propose to this announcement is extremely helpful to NASA for purposes of planning the proposal evaluation, and, therefore, is mandatory. The mandatory NOI will take the form of a Step-1 pre-proposal in NSPIRES (see Section 5.2 below). It is desired by NASA AES that all NOIs have the entire investigation team identified within the NOI to allow for the identification of un-conflicted evaluators by the proposal due date. NASA AES requests that proposers communicate any changes to the investigation team between NOI and proposal submission to the POC identified in Section 7 of this PEA. NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA.

Sections 5.2 below and 6.1.2 of the SALMON-2 AO provides information on electronic NOI submission through NSPIRES. Submitting an NOI does not commit the team to submitting a proposal. All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.

NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four weeks following receipt of the Statement of Work, as set forth in Section 6.3.1 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Propose

Prospective investigators from any category of organizations or institutions, U.S or non-U.S., are welcome to respond to this solicitation. Specific categories of organizations and institutions that are welcome to respond include, but are not limited to, educational, industrial, and not-for-profit organizations, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), NASA Centers, the Jet Propulsion Laboratory (JPL), and other Government agencies. Refer to Section 4.2 of the SALMON-2 AO for the full rules on participation policy.

Owing to NASA's policy to conduct research with non-U.S. entities on a cooperative, no-exchange-of-funds basis, NASA does not normally fund non-U.S. research proposals or non-U.S. research efforts that are part of U.S. research proposals. Rather, cooperative research efforts are normally implemented via agreements between NASA and the appropriate non-U.S. entity. Non-U.S. proposers, whether as primary proposers or as participants in U.S. research efforts, must arrange for non-U.S. financing for their portion of the research and provide a Letter of Commitment from the funding entity (See Section 5.9 of the SALMON-2 AO for more information).

For this particular PEA, NASA will place full or partial limitations (as described in the

SALMON-2 AO Section 4.2.1) on organizations that will be involved in the evaluation process. The VALADOR company and its subcontractor, Stellar Solutions, Inc., are subject to the “Full Limitation” as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on the Aerospace Corporation or Cornell Technical Services LLC for this PEA.”

4.2 Type of Mission of Opportunity

In the context of the SALMON-2 AO, this PEA is a Focused Mission of Opportunity (FMO). A FMO is one that addresses a specific, NASA-identified flight opportunity that fulfills the solicited objectives and includes all of the elements specified in this document and in the SALMON-2 AO.

The investigation PI is responsible for conducting the proposed science investigation which includes, but is not limited to: (i) development and delivery of the instrument or instrument package; (ii) working with NASA to integrate the instrument on the KPLO platform; (iii) commissioning, validating, and operating the instrument and ground systems on-orbit in order to carry out the proposed science investigation; (iv) preparing and delivering appropriate data analysis software, including required calibration data, analyzing the data, publicly distributing all the proposed investigation data from the prime mission phase to the scientific community, archiving the data in NASA’s Planetary Data System (PDS) and reporting the results of the science investigation in the scientific literature.

4.3 Science Requirements and Constraints

The science objectives are fully described in Section 2 of this PEA. Any appropriate science question relevant to those SKGs using the NASA-supplied KPLO instruments can be addressed with the proposed investigations. Section 2 provides the basis for the evaluation of intrinsic science merit as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside of the KPLO science objectives as described in Section 2.2.1 are not solicited through this call.

Requirement 1. Each proposal shall clearly define its science question or questions, shall demonstrate how the science questions map into relevant AES SKGs and lunar volatiles SKGs as described in section 2 of this PEA, and shall show how the science requirements subsequently map into the measurement and instrument performance requirements.

Requirement 2. Proposals shall address how the proposal is non-redundant to the KARI instrument suite yet provides science relevant to AES SKGs and lunar volatiles as described in Section 2 of this PEA.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement 3. Each proposal shall clearly state the baseline and threshold requirements for the performance of the instrument, the prime mission lifetime for operation of the instrument and provide a justification for the use of the KPLO orbit to be acceptable or required for operation of the instrument.

A Co-Investigator (Co-I) is defined as an investigator who plays a necessary role in the proposed investigation and whose services are either funded by NASA or are contributed by his/her employer. Every Co-I must have a role that is required for the successful development and/or

operation (including initial data analysis) of the instrument science investigation, and the necessity of that role must be justified. Co-Is with roles limited to operations and/or initial data analysis need not be named at this time, but may be identified by the PI after launch, with NASA concurrence. In such cases the role, expertise, and budget for the unnamed Co-I should be included in the proposal. The inclusion of any unjustified Co-Is will result in the downgrading of an investigation and/or the offer of only a partial selection by NASA.

Requirement 4. Proposals shall designate all Co-Is, describe the role of each Co-I in the instrument investigation, state the annual time commitment of each Co-I, and justify the necessary nature of the role; see Section 5.6 of the SALMON-2 AO.

4.4 Cost and Schedule Requirements and Constraints

4.4.1 Cost Requirements and Constraints

There is a maximum cost for the payload(s) of \$15M as a whole and a maximum of two physical instrument packages which may contain more than one instrument. NASA intends to make up to 4 awards totaling up to this amount. Cost will be a significant driver in the payload(s) selection. The level of funding available for each selected proposal will be decided on a case-by-case basis and will be capped at that level.

4.4.1.1 PI-Managed Investigation Cost

Each selected investigation is PI-Managed, and the PI will be responsible for defining and controlling the costs within the proposed budget for each phase of the investigation. Not all costs cannot be defined and controlled by the PI since NASA will be arranging the spacecraft for the instrument investigations, and these costs are outside the established PI-Managed Investigation Cost. This section identifies those costs that are within the PI-Managed Investigation Cost and those costs that are outside the constrained PI-Managed Investigation Cost. A summary of budgeted costs that are and are not to be included in the PI-Managed cost cap for Instrument Investigations is listed in Table 2.

Contributions from sources other than NASA, whether the sources are U.S. or non-U.S., are welcome, provided they comply with section 4 of the SALMON-2 AO. These may include, but are not limited to, labor, services, and/or contributions to the instrument investigation, subject to the following exceptions and limitations: contributions of non-U.S. nuclear power or thermal sources are prohibited.

Costs that are within the PI-Managed Investigation Cost include: instrument development and delivery ready for integration onto the selected platform (Phases A-C); labor required to assist with integration to the NASA-provided platform (Phase D); development and delivery of functional algorithms, engineering models, and ground processing system (Phases B-D); supporting a Joint Science Team (JST) (see Section 4.5.8 of this document) that will contribute directly to the successful implementation of the investigation (Phases A-F); required calibration and validation and verification activities (Phases C-E); operations, product generation, and data analysis during the proposed prime mission lifetime of the investigation (Phases E); and close out of the investigation once the investigation has been concluded (Phase F). The PI-Managed Investigation Cost also includes the cost of the JST and of key management, instrument, and engineering staff during Phase D. For support of the JST and key management and engineering during Phase D, a duration of 12 months should be assumed for budgeting purposes.

It is understood that some changes will be possibly required to respond to NASA or KARI programmatic decisions that could alter the proposed PI-Managed Investigation Cost after the KPLO spacecraft parameters are better defined.

Costs that are outside the PI-Managed Investigation Cost include investigation costs during any potential gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the KPLO spacecraft (start of Phase D); and access to space, which is provided by KARI.

Portion of the Investigation	Within PI-Managed Costs	Outside PI-Managed Costs
Phase A (Preliminary Analysis)	X	
Phase B (Definition)	X	
Phase C (Design and Development)	X	
Phase D (Integration)	X	
Investigation Costs during a potential gap between completion of instrument and start of integration (planning budget up to 2 years, on a per-year basis)		X
Calibration/Validation planning (all phases)	X	
Postlaunch instrument commissioning activity (within Phase D)	X	
Phase E (Mission Operation, future budget)	X	
Phase F (Close Out of the Investigation, future budget)	X	
Cost for access to space		X
Non-NASA Contributions		X
Core E/PO program, not required, see section 4.6.		X
Student Collaboration (SC) (optional)	X	

Table 1. List of which portions of an instrument investigation are within and outside the PI-Managed Investigation Cost. Budgets for items within and outside of PI-Managed Investigation costs are required except for access to space and E/PO.

NASA intends to provide the instruments to complement the KPLO mission suite. If the NASA instrument development undergoes delays, which prohibit delivery in time to support the delivery and launch on the KPLO mission in December 2018, NASA believes the importance of addressing the lunar SKGs is essential and will attempt to identify subsequent launch opportunities on host spacecraft. For this delay contingency, this PEA also requires proposals to include plans and planning budgets that estimate the minimum costs for the project if there is a gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D). These “gap planning” budgets should be on a per-year basis and should address a one and two year delay. The costs for these planning budgets are outside of the PI-Managed Investigation Cost.

Proposers should propose a funding profile that is appropriate for their investigation. However, NASA cannot guarantee that every proposed funding profile can be accommodated. The inability of NASA to accommodate the requested funding profile may be a reason for non-selection of a

proposal. A final funding profile and instrument delivery schedule for all selected investigations will be negotiated between NASA and the selected investigation team.

Requirement 5. Proposals shall include complete, detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Investigation Cost (see Table 2).

Requirement 6. Proposals shall include integration plans and planning budgets that occur during Phase D, with the assumption that this phase will take approximately 12 months. This cost is included as part of the PI-Managed Investigation Cost.

Requirement 7. Proposals shall include plans and planning budgets for the required costs to minimally support the project and science during a potential gap between instrument delivery (end of Phase C) and the start of integration with the spacecraft (start of Phase D). These budgets should be on a per year basis for up to two years. These costs are outside the PI-Managed Investigation Cost.

4.4.1.2 Full Cost Accounting for NASA Facilities and Personnel

This Section supersedes Section 5.5.5 of the SALMON-2 AO.

For NASA-center led proposals, Centers should propose under NASA's full cost accounting practices, including civil servant labor (salaries and benefits), civil service travel, and procurements.

For non NASA-center led proposals, PIs should separate calculation of the full cost of NASA provided services within the PI Managed Investigation Cost for purposes of proposal evaluation. Relevant center(s) should provide PIs with budgets prepared under NASA's full cost accounting practices, including civil servant labor (salaries and benefits), civil service travel, and procurements; and a letter of commitment. NASA HEOMD/AES will fund these activities directly and provide resources as GFE to selected PI(s).

In either case, all of these costs must be clearly identified by year within the budget justification section of the proposal.

Estimated NASA Center Management and Operations (CM&O) overhead costs must also be included within the budget, to enable a level playing field for all proposers. Per HQ policy guidance signed in June 2010 by the Associate Administrator, Mission Support Directorate and by the Agency Chief Financial Officer, all Centers shall use an identical CM&O burden rate of \$43K (RY) per "equivalent head." As per Agency policy, this rate must be applied as a "cost per equivalent head" to all Civil Service FTEs plus on/near site contractor WYEs associated with the proposal. The estimated FTEs and WYEs per fiscal year, and the resulting CM&O burden, must be identified in a separate table within the budget justification section of the proposal.

The CM&O burden costs must be clearly denoted in all budget tables. These costs may not be included or rolled into any other budget lines in such a way that they become unidentifiable.

Do not include within the cost proposal, or within the PI Managed Investigation Cost, any estimate for Agency Management and Operations (AM&O, a.k.a. NASA Headquarters overhead).

	Identify in proposal?	Include in PI-managed Investigation cost?	Funding source	Comments
Civil Service Labor	Yes	Yes	AES Program	Includes salaries and benefits
Civil Service Travel	Yes	Yes	AES Program	
Other Direct/Procurements	Yes	Yes	AES Program	Includes procurements as typically identified by flight projects in the NASA N2 budget database
CM&O	Yes	Yes	CASP	Applied to NASA provided labor, including Center civil servants and on-site contractors
AM&O	No	No	CASP	
NASA Contributed Costs	Yes	No	Identify	Must be non-AES/HEOMD
Non-NASA Federal Government (funding requested from NASA)	Yes	Yes	AES Program	If NASA funding is requested for the non-NASA Federal Government agency
Contributions	Yes	No	Identify	Includes all non-NASA Contributions

Table 2. Cost Elements for NASA Center Budget Proposals in response to HEOMD AOs

Requirement 8. Proposals including costs for NASA Centers shall conform to the full cost policy stated in this Section. Each of the elements of the NASA Center costs (direct labor, travel, and procurements) shall be separately identified by year.

If any NASA funded item(s) or services are to be considered as contributed costs, then the contributed item(s) must be separately funded by a non-AES/HEOMD effort complementary to the proposed investigation, the value of the contribution(s) must be estimated, and the funding source(s) must be identified.

Requirement 9. If any NASA funded item(s) or services are considered as contributed costs, then the proposal shall estimate the value of the contribution(s) and shall identify the funding source(s).

Any non-NASA Federal Government costs must follow the appropriate agency accounting standards for full cost. If no standards are in effect, the proposers must follow the Managerial Cost Accounting Concepts and Standards for the Federal Government, as recommended by the Federal Accounting Standards Advisory Board and available in the Program Library.

Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

4.4.2 Schedule Requirements and Constraints

Each selected instrument investigation under this KPLO instrument investigation solicitation will be expected to deliver an instrument that can be integrated and tested onto the KPLO spacecraft platform to support a launch in December 2018. . Nominally, the development of the selected

investigation(s) will span the years of FY 2017-FY 2018. This is expected to cover development Phases A through C. Proposals that include a more rapid instrument development timelines may be selected, provided the required budget phasing can be accommodated by NASA.

Requirement 10. Proposals shall include a development schedule that delivers an instrument for integration onto KPLO no later than December 2017 and completes integration within approximately 12 months. Proposals may extend development timelines by reducing the Launch -12 month time by providing sufficient rationale for discussion with the KPLO spacecraft integration team.

4.5 Technical Requirements and Constraints

4.5.1 *New Technologies/Advanced Engineering Development*

This Section intends to clarify the requirement for New Technologies and/or Advanced Engineering Developments and supersedes Section 5.3.4 of the SALMON-2 AO.

This AO solicits instruments for flight missions, not technology or advanced engineering development projects. Proposed investigations are generally expected to have mature technologies, with systems at a Technology Readiness Level (TRL) of 6 or higher. For the purpose of TRL assessment, systems are defined as level 3 WBS payload developments (i.e., individual instruments); see Figure 3-7 of the *NASA WBS Handbook*, NASA/SP-2010-3404, which can be found in the Program Library (provided alongside this Appendix). TRLs are defined in NPR 7123.1B *NASA Systems Engineering Processes and Requirements*, Appendix E, which can be found in the Program Library.

Proposals with a limited number of less mature technologies and/or advanced engineering developments are permitted as long as they contain a plan for maturing systems to TRL 6 (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*) by no later than Preliminary Design Review (PDR) and adequate backup plans that will provide mitigation in the event that the systems cannot be matured as planned. The TRL of systems will be validated by an independent team at PDR.

Requirement 11. Proposals that use systems currently at less than TRL 6 shall include a plan for system maturation to TRL 6 by no later than PDR and a backup plan in the event that the proposed systems cannot be matured as planned (see Section 5.1 of this PEA, for additional detail).

4.5.2 *Payload Requirements for Proposed Investigations*

The NASA sponsored payloads will be hosted by the KARI-managed KPLO mission. The payload constraints are dictated by the capabilities of the KPLO mission and the allotment NASA has received. The payloads should in their submittal account for adequate margins against each constraint below:

1) *Mass*

Total mass of NASA instrument(s) shall be less than 15 kg including mass for cable harness, mechanical and electrical integration onto KPLO spacecraft and thermal control.

2) *Power and signal interface*

Orbit average power consumption of NASA instrument(s) including electrical power for thermal control shall be less than 15 watts. Power signal shall be unregulated 28 volts (24V-32.8V). Peak power is limited to 70 watts.

3) *Mechanical interface*

KPLO spacecraft main body size is 1.3 x 1.3 x 1.3 m [TBD] based on the baseline design. The deck facing the Moon (a deck in +z direction) will accommodate a KARI high resolution camera, a wide angle polarimetric camera, a gamma ray spectrometer, and a magnetometer in addition to the NASA-supplied instruments. Volume for the NASA provided instrument(s) is strongly dependent on where the NASA instrument(s) need to be located. KARI and NASA will further refine maximum allowable volume, required location and field of view of the NASA instrument(s).

4) *Thermal interface*

If there is an instrument box that should be located inside of the KPLO structure, KARI may provide thermal control. However, it is necessary to discuss based on allowable power dissipation and temperature range that will be defined later.

If an instrument is located outside of KPLO structure, the equipment should be thermally isolated from the KPLO and that instrument should have thermal control capability.

5) *Maximum Number of Instruments*

Maximum allowable number of NASA-provided physically separate instruments is two (2) although multiple instruments may reside in one physical unit.

6) *Operational Constraints*

Concept of operation during the nominal lunar orbit operation phase is being under discussion in KARI. It should be noted that there is possibility of a 180 degree yaw maneuver to direct KPLO solar array to the Sun and that there is possibility of limiting the duration of nadir pointing per an orbit with x-axis being parallel with the velocity direction which is normally used for imaging operation. Limiting the duration of nadir pointing is coming from yaw steering operation to keep the solar panel facing the Sun when the angle between the orbit plane and the Sun is high.

7) *Communication Data Bus and Data Volume*

KARI is considering MIL-1553B, CAN, and RS-422 as candidate data bus protocols between KPLO spacecraft and scientific instruments. Selection will be done when baseline of the KPLO spacecraft electrical architecture is fixed later in CY2016. The KPLO spacecraft will be able to utilize a maximum of 5Mbps downlink for the KARI and NASA instrument suite and downlink times will vary depending on the available KARI and NASA Deep Space Network antenna availability.

As the KPLO mission bus is evolving, these payload requirements will be updated, if necessary, after instrument selections and during discussions with instrument investigators.

4.5.3 Planetary Protection (PP)

The KPLO mission is being developed by KARI, thus the payloads solicited under the aegis of this solicitation are will be governed by Section 2.2 (NASA Participation in non-NASA Missions) of NPR 8020.12 (Planetary Protection Provisions for Robotic Extraterrestrial Missions). Per Section 2.2.1.1, PP categorization and certification of compliance for the spacecraft shall be the sole responsibility of the lead agency on the mission, which is this case is

KARI. NASA will ensure that it will comply with Section 2.2.1.3 of NPR 8020.12 whereby all payload development activities shall be performed consistent with US obligation under the 1967 Outer Space Treaty.

For additional information, proposers may contact the NASA Planetary Protection Officer, Dr. Catharine A. Conley (Telephone: 202-358-3912; E-mail: cassie.conley@nasa.gov)

4.5.4 Instrument Investigation Science Instrument System and Payload Requirements for Proposed Investigations

The KPLO is the intended platform for the proposed instruments and the final requirements for mass, instrument dimensions, power consumption, data rate requirements, platform stabilization requirements, observational geometry requirements, launch vibration constraints, and orbit around the Moon. All of these parameters must be well characterized and clearly stated within the proposal, preferably in a single table, in order for NASA to determine the feasibility of accommodating the proposed instrument investigation.

Requirement 12. Proposals shall clearly state the proposed instrument mass, volume dimensions, power requirements, platform stabilization requirements, thermal requirements, observational geometry requirements, launch vibration constraints, electromagnetic interference/electromagnetic compatibility (EMI/EMC) requirements, data rate requirements, and all other requirements (or constraints, preferences, etc.) that the instrument places on the platform for accommodation, launch, deployment, operations, etc. A template is provided on the KPLO Program Library (provided alongside this appendix) to aid proposers to provide this data. This table shall be provided in the experiment implementation section (Section E) of the proposal. This table does not count towards the proposal page limit.

Since the KPLO mission architecture and spacecraft are still in the definition phase, the available payload resources, including size, mass, power, thermal control, pointing stability, pointing ability, orbits, and data rates, are provided as a guidance at this time. This information reflects NASA's best understanding of mission concepts that are judged to be both compelling and feasible. However, the final mission architecture and its associated payload parameters and resources are not yet determined. Proposals may include information on any research the proposing team has done relative to potential payload accommodations for their proposed instrument. This is not a requirement for any proposal. However, such information can serve to demonstrate to NASA the potential of accommodating the proposed instrument. If a proposal includes such information, effort should be made to address all known integration criteria and make clear which integration criteria have not been completely researched. Failure to include such research will not be counted against a proposal in evaluation. Inclusion of such information has the potential to support the arguments within a proposal that the instrument has an acceptable chance of being integrated on a platform within an appropriate time frame.

4.5.5 Orbit Requirements

The mission architectures under consideration (orbiter) present distinct orbit and environmental requirements on the payload. Proposers must consider these requirements and describe the instrument investigation's ability to operate in these orbits and their associated environments.

Requirement 13. Proposals shall clearly state the ability of the instrument to operate in the orbits and environments expected for the KPLO mission and provide operational constraints (e.g., duty cycle or observational cadence) on the instrument.

4.5.6 Payload Risk Classification

NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, establishes guidelines for categorizing NASA missions based on the estimated total mission cost and mission priority level. The mission categorization guidelines are given in Section 2.1.4 and Table 2-1 of NPR 7120.5E.

NPR 8705.4, *Risk Classification for NASA Payloads*, establishes baseline criteria that enable a definition of the risk classification level for NASA payloads. It defines four payload risk levels or classes, A through D, and provides guidance for programmatic options during development based on this class. The requirements for each class are specified in Appendix B of NPR 8705.4.

NASA expects to designate the hosted KPLO instrument(s) as payload risk Class D (per NPR 8705.4). Proposers are advised that instruments will be managed within a corresponding framework and that requirements will be flowed down to the instrument investigations. Proposers shall incorporate appropriate work effort and support in their proposals accordingly.

4.5.7 End-of Mission Spacecraft Disposal

This Section provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO.

Section 5.3.10 of the SALMON-2 AO discusses the requirements related to end-of-mission spacecraft disposal for Partner Missions of Opportunity and hosted payloads where the PI is not responsible for the host mission. In the case of KPLO, the host mission is responsible for deorbit and impact into the lunar surface, so there is no possibility of the instrument contributing to orbital debris. However, all payloads must be passivated prior to initiating end-of-mission disposal. For instrument investigation proposals, information shall be included regarding the instrument's plan for passivation at the end of operations or in preparation for end-of-mission disposal.

Requirement 14. Instrument investigation proposals shall describe the instrument's passivation plans at end-of-mission. This supersedes Requirement 39 in the SALMON-2 AO for instrument investigation proposals.

4.5.8 Science Data Policy

This Section provides data policies and supersedes Section 4.4 of the SALMON-2 AO.

For planning purposes for proposals, proposers responding to this PEA should abide by the science data policy described below. Selected instrument investigations will be expected to abide by the science data policies finalized by the KARI-NASA team.

- a. Each Instrument proposed shall be supported by a Joint Science Team (JST) consisting of PI-appointed scientists, NASA-appointed Scientists, and KARI-appointed scientists, that will jointly reduce and analyze data.
- b. The PI shall ensure that instrument data and products are immediately available, free of

charge, to members of the other KPLO Instrument Teams, as defined in section 4.5.8.1, below.

- c. The instrument investigators have the right to access and use data from all other KPLO instruments for their investigations but shall not publish the data, until permission is obtained by NASA.
- d. The PI shall ensure that raw and partially processed scientific data is archived to the international scientific community as defined in section 4.5.8.3 below, after a data validation and verification period of no longer than twelve (12) months which begins with the receipt of the data from the spacecraft instruments.

4.5.8.1 Data Analysis

The Joint Science Team will be responsible for analysis of the investigation data necessary to achieve the proposed science objectives, for publicly distributing all data collected by the instrument(s) and produced by the investigation prime measurement phase, for archiving the data in the NASA PDS for public use, and for publication of initial scientific data in refereed scientific journals, as part of their investigation operations (Phase E) or postmission activities. Science studies with the archived data sets beyond the science investigations proposed by PI-led team may be solicited and selected by NASA in subsequent NASA solicitations.

- Proposers are expected to include, as part of their proposed investigation Operations and Data Analysis activities, a clear definition of the roles of all the investigation team members, and a data analysis plan that is consistent with Planetary Data System (PDS) archiving activities.
- Cost estimates for PI investigation instrument team activities will cover all phases, including investigation operations and data analysis.

Where applicable, instrument investigations are required to share data immediately with other KPLO instrument science team members so as to enhance the scientific return from the mission in accordance with the procedures to be agreed and formalized within the instrument science team as documented above.

Requirement 15. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final flight calibration and validation and verification of the measurements. In accordance with the Science Data policy requirement for open data and related software, any specialized software and algorithms required for basic data analysis and processing will be made available by the PI to the science community and public with appropriate documentation.

Requirement 16. Proposals shall clearly present a plan for a Joint Science Team analysis of the investigation data leading to completion of the proposed science investigation and achieving the identified investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.5.8.2 Data Rights

By NASA policy, PIs do not have exclusive use of data taken during their investigation; the Government generally obtains unlimited rights in all data. For this mission: following a verification and validation period, all data will be made available to the user community as described in the Science Data policy, above. The principal investigator shall propose and justify the data product latency period for standard products listed in the proposal, based primarily on the time required to produce, quality-check, and validate the products. Barring exceptional circumstances, data product latency may not exceed 12 months. Image data is to be made available publicly shortly after reception on the ground and in accordance with the Science Data Policy, above. After the initial archiving of data, subsequent archival will occur every 3 months. Each particular archival will, therefore, include the data that were collected either 9 to 12 months previously for raw and partially processed data, or 15-18 months previously for the calibrated data.

Requirement 17. Proposals shall include a clear commitment to minimizing the latency for data products after a required 12 month Validation and Verification period. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.5.8.3 Delivery of Data to Archive

Investigation data will be made fully available to the public by the investigator team through the PDS in usable form and, barring exceptional circumstances, within timelines described in the Science Data policy, above. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data in physical units that are usable by the scientific community at large, prior to making it fully available. By no later than the investigation closeout, the investigation will deliver to the PDS all final data products, along with the scientific algorithm software, coefficients, ancillary data used to generate these products, and the algorithm and calibration documentation. Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the PI-Managed Investigation Cost.

Archival data products will include pre-flight and in flight radiometric and geometric calibration data, ancillary and/or engineering data needed or simply useful for the full understanding of the experiment, and observation geometry data (such as that supplied by valid SPICE kernels). Additionally, low-level (raw) data, high-level (processed) data, and derived data products (such as maps, ancillary data, calibration data (ground and in-flight)) will be included in the archival data products. If derived data products such as maps are to be considered a result of the proposed experiment, these must also be archived with suitable documentation. Complete documentation of the experiment and related software and/or other tools or parameters that are necessary to interpret the data shall also be included. The inclusion of software in an archive may be appropriate, although this can present special problems and should be discussed with the relevant archive.

PDS proposal information can be found at: <https://pds.nasa.gov/pds4/propose/proposing.shtml>. Proposers should consider all requirements for the SALMON-2 AO for PEA (<https://pds.nasa.gov/pds4/ea/ea.shtml>) to apply to this SALMON-2 AO as well.

Requirement 18. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving shall be described. The

science products (e.g., flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the formats and standards to be used, selected from the published list of approved PDS Standards. It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community. Proposals shall identify how they plan to satisfy the policies in Section 4.4 of the SALMON-2 AO from the standpoint of hardware, software, personnel, and cost. This supersedes Requirement B-21 in Appendix B of the SALMON-2 AO.

4.6 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are specified in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.4.1.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirement and constraints for that specific solicitation, including the sponsoring NASA Headquarters (HQ) mission directorate and division, the type of MO, the cost cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2, the cost guidelines are discussed in Section 4.4.1, and the schedule constraint is specified in Section 4.4.2.
- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. The NASA Center for program office is specified in Section 2.4. A program-specific safety, reliability, and quality assurance document will be provided 6 months after the selection of the proposal.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the mission category and the payload risk classifications are specified in Section 4.5.6.
- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation in this solicitation. For this PEA, those limitations are specified in Section 4.1
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Investigation Cost and the Total Investigation Cost. For this PEA, that information is specified in Section 4.4.1.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.4.1 and 4.4.2.
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Section 3 that evaluation and selection will be done using a two-step selection process although NASA may choose to condense the process to a single step. Additional details on the implementation of the two-step process can be found on Section 6.3 of this PEA.

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- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an E/PO program that is consistent with NASA SMD policy is required. This PEA states that an E/PO program is not required, pending further NASA guidance for E/PO policy, and Requirements 68, 69, and 70 of the SALMON-2 AO do not apply to this PEA. Proposals should not include an E/PO plan or budget. NASA reserves the right to request an E/PO program from the selected investigation(s) at 1% of the proposed PI managed budget, and outside the PI managed budget, pending further guidance on E/PO policy.
- Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA. As indicated in Section 4.4.1.1 of this PEA, no Student Collaboration incentive is offered and the full cost of the Student Collaboration is part of the PI-Managed Investigation Cost.
- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by HEOMD/AES and it does not permit contributions of funding from NASA HEOMD programs other than the funding offered through this PEA.
- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection Official. This PEA identifies the Selection Official in Section 6.2.

5 PROPOSAL PREPARATION AND SUBMISSION

5.1 Proposal Content Requirements

Requirement 19. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO.

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA reviewers.

The key data associated with the electronic submission of proposals (see Section 6.2 of the SALMON-2 AO) includes questions indicating whether or not a proposal contains export-controlled information (see Sections 5.9.4 and 5.10.2 of the SALMON-2 AO). All proposers must answer these questions YES or NO when completing the electronic submission; these questions shall not be left unanswered.

All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO. To the extent possible, ITAR sensitive material should be organized into separate clearly marked sections.

Below, requirements B-23, B-24, B-27, and B-58 of Appendix B of the SALMON-2 AO are clarified for this solicitation.

Requirements O-27 and O-28 clarify the information requested on instrument resource and performance margins. Requirement O-27 and O-28 supersedes requirements B-23 and B-24 of the SALMON-2 AO.

Requirement 20. Instrument Contingencies and Margins: This section shall summarize contingencies and margins of all instrument resources. At a minimum, it shall provide estimates of implementation design margins with respect to the required performance for the following: Mass, Power, Data Storage, and any other resource requirements. For proposals for more than one instrument, the mass, telemetry, and power and reserves and margins must be identified separately for all the necessary components of each instrument in case only an individual instrument is selected from the proposed suite (see SALMON-2 AO for definitions of contingency and margin). Discuss the allocation of contingency and margin to the instrument and/or suite.

Requirement 21. Performance Margins: For the instrument performance, this section shall provide estimates of performance margin with respect to the performance requirements.

Requirement below clarifies the information requested on new technologies and/or advanced engineering development. Requirement O-29 supersedes requirement B-27 of the SALMON-2 AO.

Requirement 22. The New Technologies section shall describe any proposed new technologies and/or advanced engineering developments and the approaches that will be taken to reduce associated risks. Descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed system (level 3 WBS payload developments and level 3 WBS spacecraft elements) incorporating new technology and/or advanced engineering development at the time the proposal is submitted (for *TRL definitions*, see NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*, Appendix E, in the Program Library);
- Rationale for combining the TRL values of components and subsystems to derive each full system TRL as proposed, appropriately considering TRL states of integration (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*);
- Rationale for the stated TRL value of an element that is an adaptation of an existing element of known TRL;
- The approach for maturing each of the proposed systems to a minimum of TRL 6 by PDR:
 - Demonstration (testing) in an operational environment can be accomplished at the system level or at lower level(s);
 - If applicable, justify what demonstration(s) in an operational environment at lower level(s) (subsystem and/or subsystem-to-subsystem) would be sufficient to meet system level TRL 6, considering (i) where any new technology is to be inserted, (ii) the magnitude of engineering development to integrate elements, (iii) any inherent interdependencies between elements (e.g., critical alignments), and/or (iv) the complexity of interfaces – see the Program Library (provided alongside this appendix) for examples;
 - Include discussion of simulations, prototyping, demonstration in an operational environment, life testing, etc., as appropriate;
- An estimate of the resources (manpower, cost, and schedule) required to complete the technology and/or advanced engineering development; and
- Approaches to fallbacks/alternatives that exist and are planned, a description of the

cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance liens they impose on the baseline design, and the decision milestones for their implementation.

If no new technologies or advanced engineering development is required, system TRL 6 or above at the time of proposal submission shall be clearly demonstrated

The proposal evaluation process requires evaluators free of Conflict of Interest. In order to assist NASA in the planning of the proposal evaluation process, NASA requires a comprehensive list of proposed investigation participants.

Requirement 23. With the proposal submission via NSPIRES, the proposers shall identify any institution that is specified in the proposal but that does not appear in either the "Team Member" section (Section VI) of the cover page or in answer to the question about "participants [...] who do not appear on the proposal's cover page." The proposer shall list the institution and division name, role (e.g., solar array provider, instrument component provider), and estimated fixed year dollars to be received. This information will be used to avoid financial and organizational conflicts of interest during the evaluation process by checking evaluators against institutions that are proposed to supply materials, parts, or services.

5.2 Proposal Submission Requirements

Requirement 24. Proposals must be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only.

The following supersedes section 6.1.2 of the SALMON-2 AO. Proposals solicited through this NRA will use a 2-Step proposal process for which the mandatory NOI takes the form of a required Step-1 pre-proposal. Requirement 94 of the SALMON2-AO (requiring NSPIRES registration of all team members/organizations before submission) will be in effect for the Step-1 pre-proposals. Information shall be provided for the Step-1 pre-proposals as specified in section 6.1.2 of the SALMON-2 AO for NOIs.

To initiate a Step-1 pre-proposal:

- Log in using your NSPIRES user name and password.
- Click on Proposals under the NSPIRES Options.
- Click on the Create Proposal button.
- Select "Solicitation" to prepare a new proposal.
- Click the button for ".
- Follow the step-by-step instructions provided in NSPIRES to complete your Step-1 pre-proposal.

Step-1 pre-proposals are submitted by an official (Authorized Organizational Representative or AOR) of the PI's organization after the PI has released the prepared proposal to the institution official. Following the mandatory NOI deadline, all submitters of mandatory NOIs will receive an invitation through NSPIRES to submit a full (Step-2) proposal. Proposers should log in and select

prior-phase proposal when creating an invited Step-2 proposal. Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement 25. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

5.3 Submission of Proposals by Non-U.S. Organizations

Prospective investigators from any category of organizations or institutions, U.S or non-U.S., are welcome to respond to this solicitation. See Section 4.1 for specific categories of organizations and institutions, and the basis of non-US participation.

5.4 Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this appendix, or in the documents available through the Program Library, should be sent to the E-mail address for the point of contact that is listed in Section 7 of this PEA. Responses that are helpful and informative to proposers will be posted on the website also listed in Section 7 of this PEA.

The deadline for receipt of questions is three weeks before the proposal due date listed in Section 7 of this PEA.

6 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

All proposals will not be evaluated for all Criteria. A tiered evaluation as is outlined in Section 6.2.1 will be implemented. Proposals that receive a fair or poor evaluation of the intrinsic science, exploration or technology merit of the proposed investigation will not be further evaluated.

The KPLO Secondary Payloads are to be developed on a schedule that would allow for integration of these NASA funded payloads in to the KPLO mission and is dictated by KARI. These payloads are to be developed within 12-24 months after they are selected. Therefore, the Panel evaluating the third evaluation criterion regarding the technical, management, and cost (TMC) feasibility of the investigation implementation, including cost risk, may also provide comments to NASA regarding the extent to which the proposed instrument is compatible with potential spacecraft interfaces and operations. These comments will not contribute to the TMC feasibility risk rating.

After the evaluation, but prior to the selection decision, NASA will perform an accommodation study of selectable proposals to assess the extent to which the proposed instrument is compatible with KPLO platform interfaces and operations. The accommodation assessments will be performed by firewalled members of the KPLO Secondary Payload Pre-Project Office and will be chaired by Cognizant AES NASA HQ Official.

6.2 Selection Process

6.2.1 Evaluation of Investigations

Per the recommendation of the evaluation panel, the Advanced Exploration Systems Division Director will make Selection decisions based on the evaluation criteria in this AO Reports and on programmatic considerations. The criteria for evaluating the concept study are as follows:

- I. Intrinsic science, exploration or technology merit of the proposed investigation;
- II. Experiment science, exploration, or technology implementation merit and the feasibility of the proposed investigation; and
- III. Technical, management, and cost (TMC) feasibility of the proposed investigation, including cost risk.

The evaluation criteria are described in detail Section 7.2 of the SALMON-2 AO (<https://nspires.nasaprs.com/external/solicitations/summary.do?method=init&soId={12429F12-CBF0-EA11-C7C1-4DF5F4B5BA0F}&path=open>)

Proposals that receive an Excellent, Very Good or Good evaluation for the Intrinsic merit (Criteria I) will be undergo further reviews for Criteria II (Implementation merit and feasibility) and Criteria III (TMC of the proposed investigation). Proposals that receive a Fair or Poor evaluation for Criteria I will be not be considered for further review.

6.2.2 Selection of Investigations

After the review by the AO Categorization and Steering Committees, the final evaluation results will be presented to the Advanced Exploration Systems Division Director, who will make the selections. As the Selection Official, the AES Division Director may consult with senior members of HEOMD and within the Agency, including the Director of the Planetary Science Division, concerning the selections.

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among selectable proposals, including, but not limited to, planning and policy considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the mission directorate. For this KPLO Instrument PEA selection, these factors also include the likelihood that the proposed instrument can be accommodated on the KPLO mission implemented by KARI.

The accommodation assessment to be conducted by firewalled members of the KPLO Secondary Payload Pre-Project Office will also inform the Selection Official of the technical, implementation, and operational risks associated with the accommodation of individual and combinations of investigations.

6.3 Implementation Activities

Proposal selection and award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO and Section 7 of this PEA with the following amendments.

6.3.1 Award Administration and Funding of Investigations

Oversight management responsibilities have been assigned to the Advanced Exploration Systems Division of HEOMD, NASA Headquarters. NASA may choose to reassign oversight management responsibilities to a NASA Center for the execution of daily project activity. The responsibilities of the NASA office will include oversight of science instrument development; coordination of Government-furnished services, equipment and facilities, coordination of the selected team with KARI for integration; and contract management for selected investigations.

The NASA office will authorize the release of funding to each selected investigation (s). The initiation of the investigation's award of the contract will take place as soon as possible after notification of selection. In order for contracts to be awarded, Statements of Work (SOWs), updated cost and pricing data are required. For reference, a SOW template is available alongside this appendix on NSPIRES. If more than one contractual arrangement between NASA and the proposing team is required, separate SOWs, updated cost, and pricing data are required for each contractual arrangement. NASA Centers will receive funding via intra-agency funding mechanisms.

Proposals are not required to include SOWs and cost and pricing data. These will be required only for investigations that are selected for award. For those investigations that are selected, it will be in the best interest of the PI-led investigation management teams to provide updated SOWs, cost and pricing data, and small business subcontracting plans in as timely a manner as possible. The process of awarding contracts cannot begin until final SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed. For each selection, and unless otherwise stated in the selection letter, the selected investigation's cost cap will be set at the proposal's proposed cost.

SOWs will be required for selected investigations, regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). For contracts that exceed \$650K, the contractor will be required to provide cost and pricing data to support the cost estimate and to certify the cost proposed for the contract in accordance with FAR 15.403-4.

Each SOW must include a commitment by the PI for the cost, schedule, and scientific performance of the investigation. For each investigation selected, and unless otherwise stated in the selection letter, the selected investigation's cost cap will be set at the Concept Study Report's proposed cost.

NASA cannot guarantee that the proposed funding profile can be accommodated within the budget. A funding profile for the selected investigation will be negotiated after selection for subsequent mission phases.

6.3.2 International Agreements

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, NASA's Office of International and Interagency Relations, Advanced Exploration Systems Division, will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will

each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency MOU.

7 SUMMARY OF KEY INFORMATION

Funding available	See Section 4.4.1 of this PEA
Release Date	September 13 th , 2016
Date for Industry Day/ Question and Answer	September 23 rd , 2016 via remote meeting; KPLO Instrument AO Q&A Friday, September 23, 2016 10:00 am Eastern Daylight Time (New York, GMT-04:00) 4 hrs Join WebEx meeting Meeting number: 996 623 444 Meeting password: Industry@9-23 Join by phone 844-467-4685 PC: 5685963#
Due Date for NOI (notice of intent to propose, mandatory)	11:59 p.m. Eastern Time on September 30 th , 2016
Date for Proposal Workshop (for proposers filing NOI)	October 3 rd , 2016 via remote meeting; Meeting information will be provided upon NOI submission
Due Date for Proposals	11:59 p.m. Eastern Time on November 18 th , 2016
Web site for additional information for the KPLO Instrument PEA	https://nspires.nasaprs.com/external/solicitations/summary.do?method=init&soIID={AF44B73B-7DBF-5540-1793-4C5491CFFE7C}&path=init
Library for the KPLO Instrument PEA	www.nasa.gov/feature/kplo-ao
Submission Medium	Electronic copies only; see Section 5.2 of this PEA
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)
NASA point of contact	Mr John Guidi NASA Headquarters Advanced Exploration Systems Division Washington, DC 20546-0001 Tel: 202-358-1644 E-mail: john.guidi@nasa.gov

National Aeronautics and Space Administration

